

## APBI AGENDA EXTRACT

Program Status--Major General Malcolm O'Neill, Deputy Director, Strategic Defense Initiative Organization

Ballistic Missile Defense and Systems Architecture--  
Dr. Edward Gerry, SDIO Systems Architect

Global Protection Against Limited Strikes (GPALS)--  
Dr. James Carlson, Deputy for Strategic Defense

System Integration & Command and Control--  
Colonel William Hecker, Director, System Integration and Command and Control Directorate

Global Missile Defense--  
Lieutenant Colonel Rohlman, Assistant Director, Program Operations Global Defense Segment Directorate

National Missile Defense--Colonel Carl Drewes,  
Director, National Defense Segment Directorate

Theater Missile Defense/Patriot--Mr. David Israel,  
Assistant Deputy, Theater Missile Defense

National Test Bed--Commander Lenio, Deputy Director,  
National Test Bed Directorate

Test and Evaluation--Colonel Michael Toole,  
Director, Test and Evaluation Directorate

Technology Overview--Colonel Simon Worden,  
Deputy for Technology

Innovative Science and Technology--Dr. Leonard Caveny,  
Assistant Director, Technology, Innovative Science and Technology Directorate

International and External Programs--  
Dr. J. David Martin, Director, SDIO International and External Programs Directorate

Program Budget Considerations--Lieutenant Colonel  
Steven Mullen, Assistant Director, Program Execution

SDIO Technical Information Center--Ms. Jeanette Clay,  
Assistant Director, System Development, Information Systems Directorate

#425

# STRATEGIC DEFENSE INITIATIVE

## Advance Planning Briefing For Industry



2 MAR 92

**MG Malcolm O'Neill, USA**  
**Deputy Director**  
**Strategic Defense Initiative Organization**



# AGENDA

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- **Situation**

- **Mission**

- **Execution**

- **Resources**

# Situation





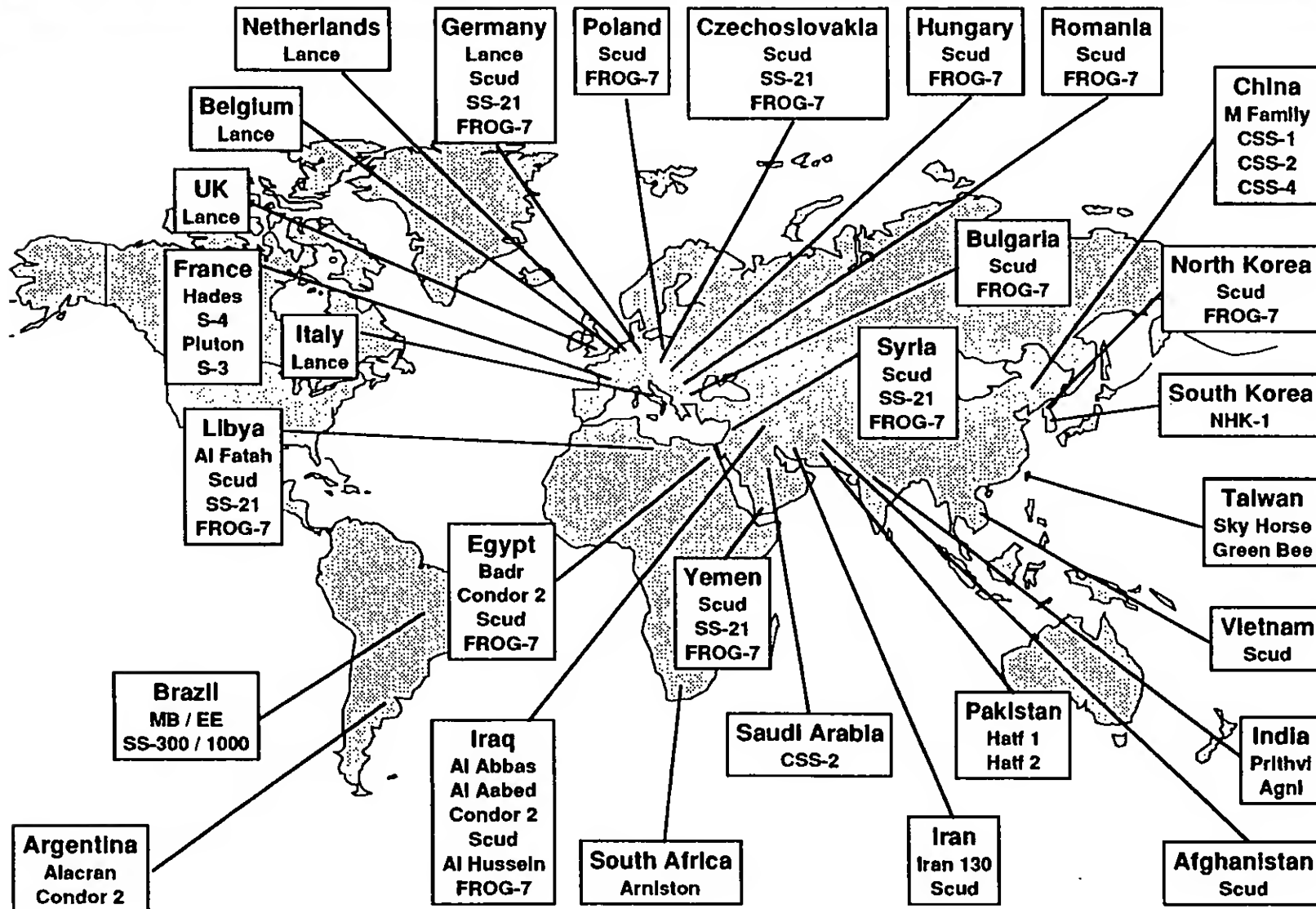
# THREAT SITUATION

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- **Evolving East - West Relations Changes Calculus**
  - **Soviet Union No Longer Exists**
  - **Republics Of The Former Soviet Union Still Retain Large, Modern Strategic Forces**
  - **Political Instabilities Increase Concern About Use Of Ballistic Missiles**
  
- **Ballistic Missile Proliferation A Growing Threat To U.S.**
  - **Directly Threatens The Republics Of The Former Soviet Union**
  
- **Threat Of Third Country Attacks Increasing**



# EVOLVING BALLISTIC MISSILE CAPABILITY



# **Friendly Situation**



# FRIENDLY SITUATION

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- **JCS Ballistic Missile Defense (BMD) Requirements In Place**

**Phase I Operational Requirements Document (ORD) And Theater Missile Defense (TMD) Mission Needs Statement (MNS)**

- **The President's 1991 State Of The Union Address**

**Refocus**

- **Missile Defense Act Of 1991**

**Early Ballistic Missile Defense Deployment**

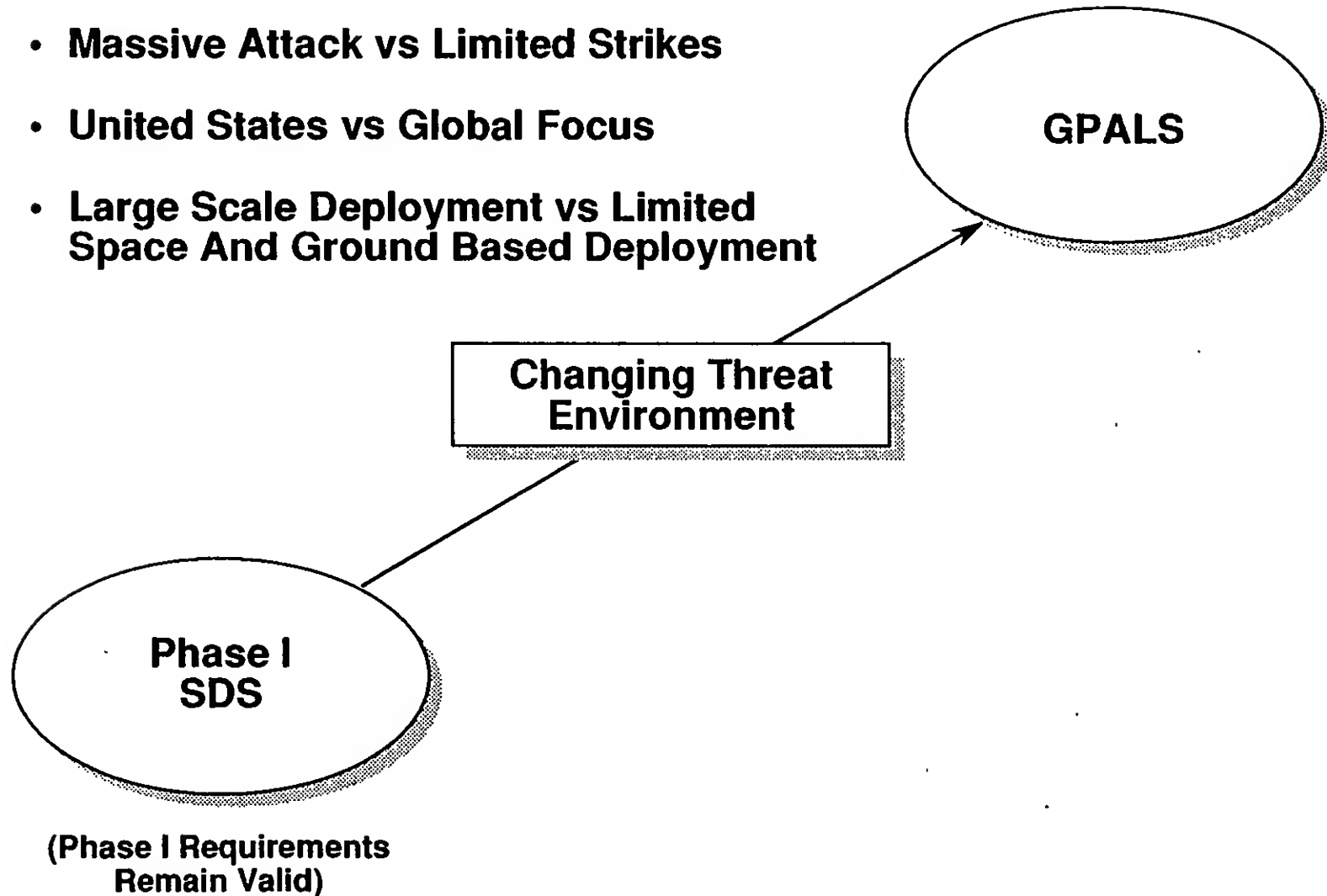
- **Soviet / U.S. Treaty Negotiations**

**ABM & START**



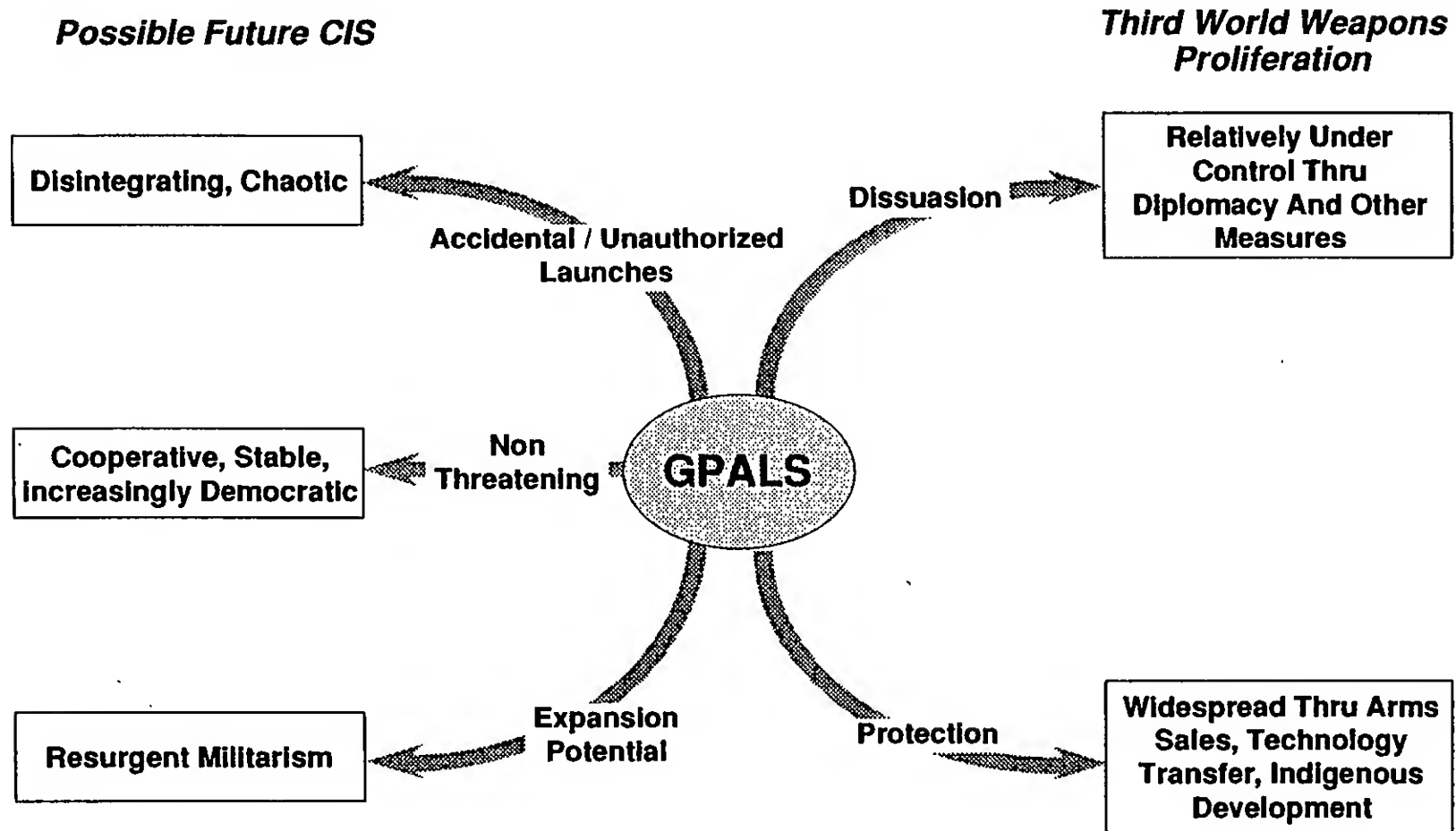
# PRESIDENTIAL REFOCUS

- **Deterrence vs Protection**
- **Massive Attack vs Limited Strikes**
- **United States vs Global Focus**
- **Large Scale Deployment vs Limited Space And Ground Based Deployment**





# DEALING WITH UNCERTAIN FUTURES





# MISSILE DEFENSE ACT OF 1991

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## *Missile Defense Goal Of The United States*

- **It Is The Goal Of The United States To**
  - **Deploy An Antiballistic Missile System, Including One Or An Adequate Additional Number Of Antiballistic Missile Sites And Space Based Sensors, That Is Capable Of Providing A Highly Effective Defense Of The United States Against Limited Attacks Of Ballistic Missiles**
  - **Maintain Strategic Stability**
  - **Provide Highly Effective Theater Missile Defenses (TMDs) To Forward Deployed And Expeditionary Elements Of The Armed Forces Of The United States And To Friends And Allies Of The United States**

# Mission





## PRESIDENTIAL DIRECTION

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***"... Looking Forward, I Have Directed That The SDI Program Be Refocused On Providing Protection From Limited Ballistic Missile Strikes, Whatever Their Source. Let Us Pursue An SDI Program That Can Deal With Any Future Threat To The United States, To Our Forces Overseas And To Our Friends And Allies."***

**President George Bush  
State Of The Union Address  
29 JAN 91**



# MISSION

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- **Respond To Missile Defense Act For**
  - **Downselect / Deployment Of Advanced TMD Systems By Mid-90s**
  - **Develop For Deployment First Site Of ABM System As Early As Practical Or By 1996**
  
- **Retain President's Vision For Final Architecture**
  
- **Include Robust Technology For Space Based Interceptor**
  
- **Support Research For**
  - **Technology Insertion**
  - **Other Follow-on Systems**

# Execution



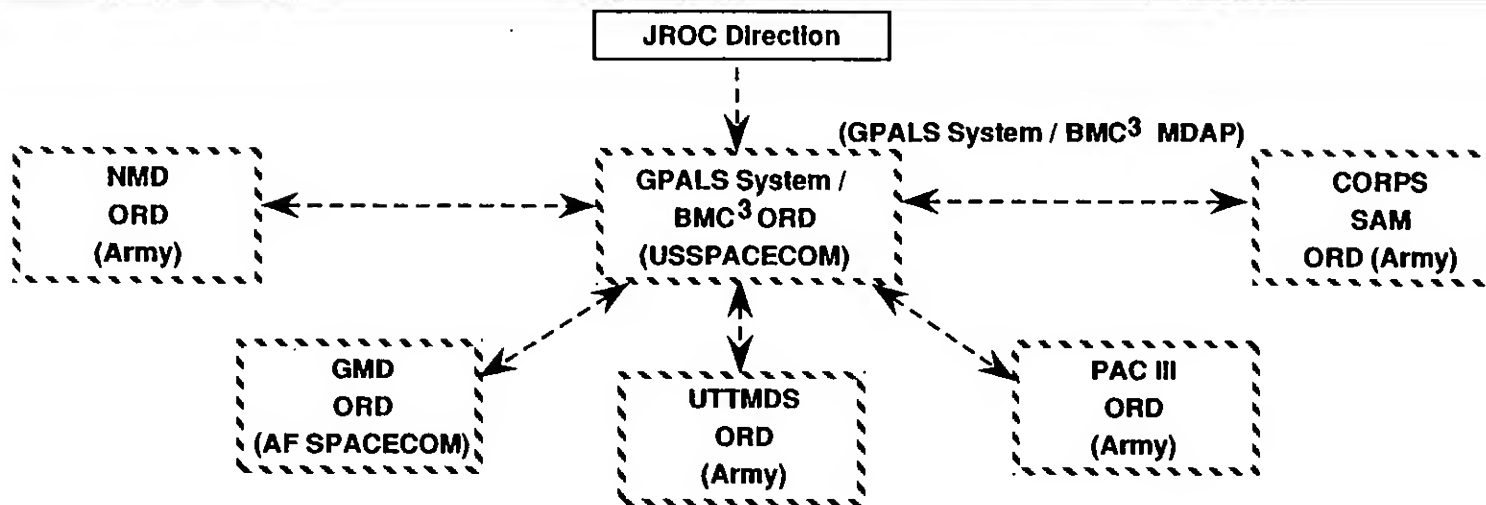
# PROGRAM ORGANIZATION

System	GPALS System					
Segments			NMD	GMD	TMD	
MDAPS	GPALS System BMC <sup>3</sup>	NMD System	GMD System	PATRIOT	CORPS SAM	Upper Tier System
Elements	Architectural Integration System Engineering And Integration Command Center Element	Ground Based Interceptor Ground Based Radar Space Based Sensor (BE)	Space Based Interceptor (BP)	PATRIOT	CORPS SAM	THAAD & TMD-GBR

**Agreed Structure Based On OSD White Paper**



# GPALS SYSTEM / BMC<sup>3</sup> REQUIREMENTS FLOW



## *JROC - Approved Schedule*

<u>Event</u>	<u>Date</u>
GPALS / BMC <sup>3</sup> ORD Submitted	3rd Qtr 1992
GPALS / BMC <sup>3</sup> ORD Validated	3rd Qtr 1992
NMD ORD And GMD ORD Submitted	3rd Qtr 1992
NMD ORD And GMD ORD Validated	4rd Qtr 1992
UTTMS ORD Submitted	1st Qtr 1993
UTTMS ORD Validated	2nd Qtr 1993



## DAB ACTIVITIES / HIGHLIGHTS

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<i>Activity</i>	<i>(Timing)</i>
• Review RFPs And Contracts For Dem / Val	(Continuing)
• Coordinate NMD / TMD Report To Congress	(Now - MAY 92)
• Establish Acquisition Planning Baseline For Each MDAP	(AUG 92)*
• Review COEA For GPALS	(JUL 92)
• Obtain CAIG Position On Cost Estimates	(MAY 92)
• Formal DAB Review / Approval Of Progress	(AUG 92)

\* Does Not Include CORPS SAM



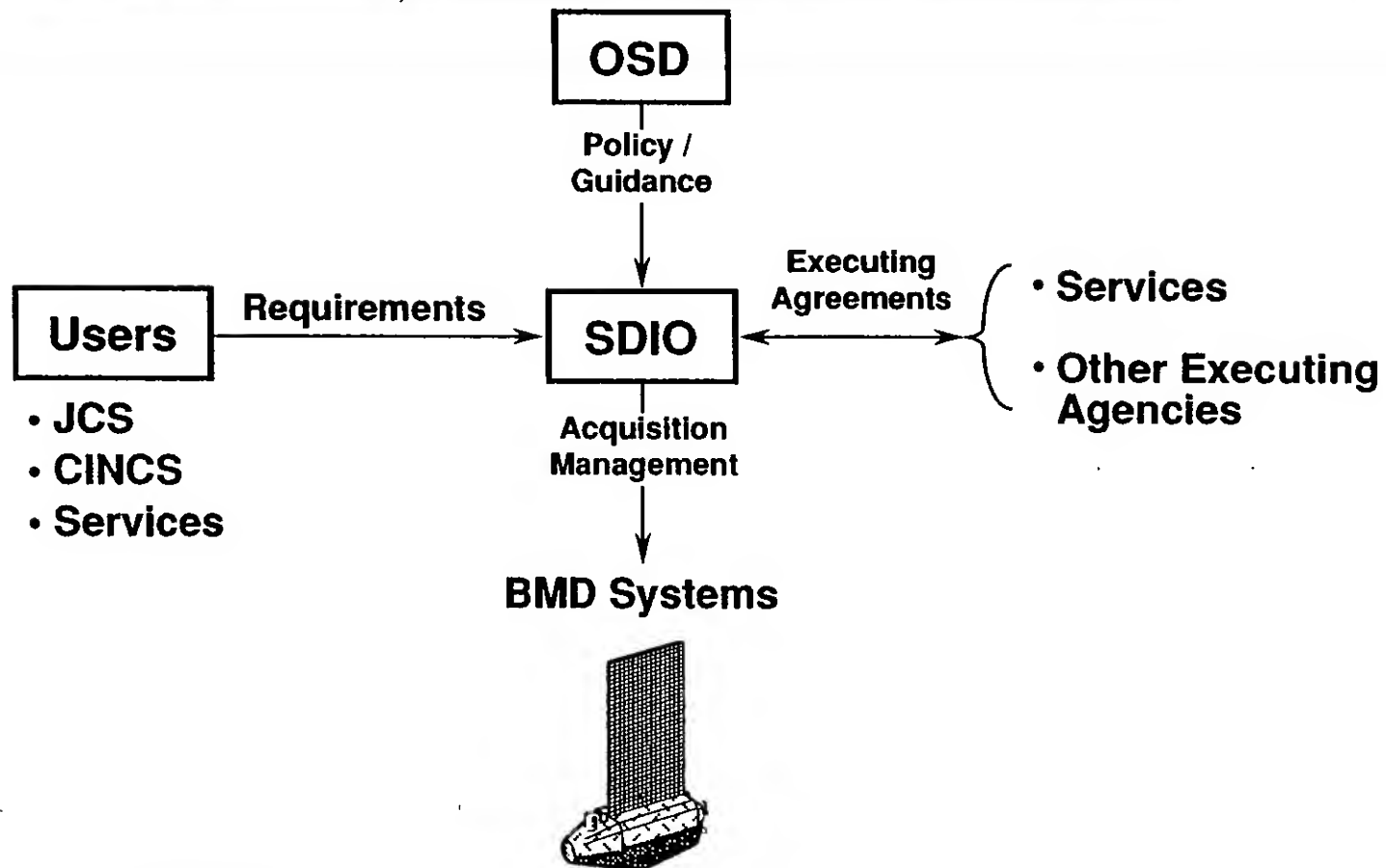
## **SDIO EVALUATING PROGRAMMATIC IMPACT OF MISSILE DEFENSE ACT ON FY 94-99 POM AND 180-DAY REPORT**

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- **Two Intense Architectural Efforts Examining Implications Of Congressional Call For Early Deployment**
  - Theater Missile Defense - Led By MG O'Neill / DD SDIO
  - U.S. Homeland Defense (Ground Based Interceptors And Ground And Space Based Sensors) - Led By Dr. Gerry / System Architect
  
- **Studies**
  - Involve Users, Operators, Service Representatives, Other SDIO Agents, System Engineer And Integration Contractor, Key SETA Support And Nationally Recognized Technical Experts
  - Addressing Programmatic / Technical Choices And Costs Of Various Options
  
- **Assessing**
  - Impact Upon Support, Tech Base And Follow-on Systems
  
- **Delivery Dates**
  - Finalize Approach By April 1992 POM Submission
  - Submit Draft Of 180-day Report To SECDEF By May 1992 As Per 6 December 1991 Guidance From DEPSECDEF (Due To Congress By June 1992)



# SDIO INTERACTIONS



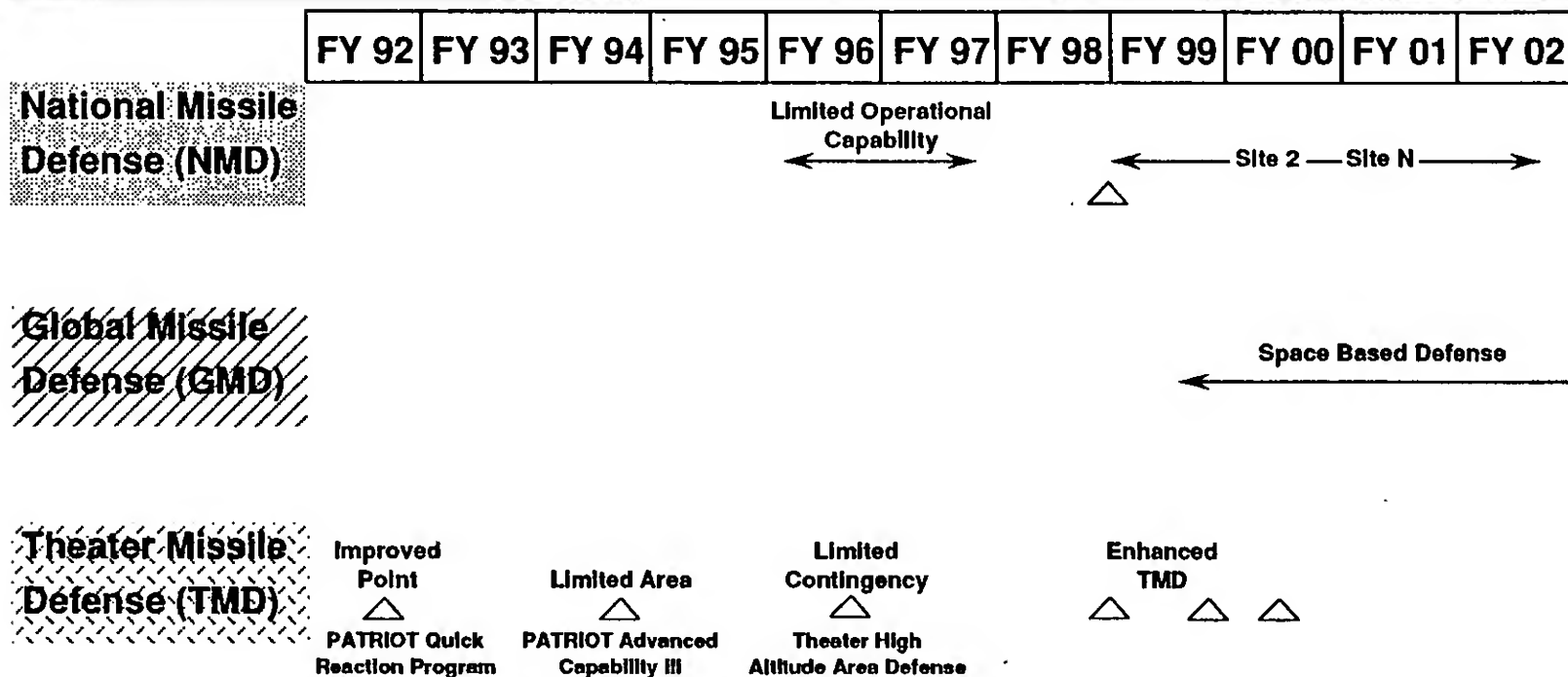
## Function:

- **Oversight And Interface With Agent**
- **Direct And Manage Acquisition Processes**





# BALLISTIC MISSILE DEFENSE CAPABILITY



- NMD LOC Circa FY 96 At Grand Forks, Expanded Later To Full NMD
- GMD Space Based Defense Capability Complements NMD / TMD
- Initial TMD Improvements In Lethality And Range Through PATRIOT Upgrades
- Limited Contingency In FY 96; UTTMDS Beyond FY 00
- CORPS SAM Matures After THAAD

# Resources



## FY 92 RDT&E BUDGET

*\$s In Millions*

<u>Program Elements</u>	<u>President's Budget</u>	<u>Appropriation</u>
Limited Defense System	1,459.530	1,411.412
Theater	857.460	868.710
Space Based Interceptor	827.177	465.000
Other Follow-on	925.149	674.852
Research - Support	1,081.258	721.627
<b>Total</b>	<b>\$5,150.574</b>	<b>\$4,141.601</b>

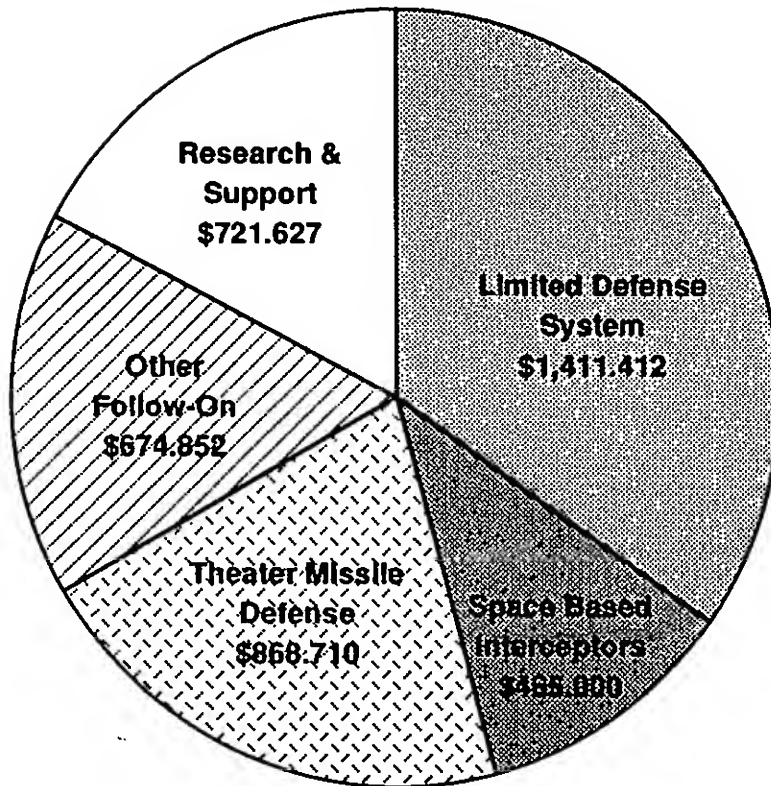
△ - \$1,008.973 M



# SDI ALLOCATION BY PROGRAM ELEMENT

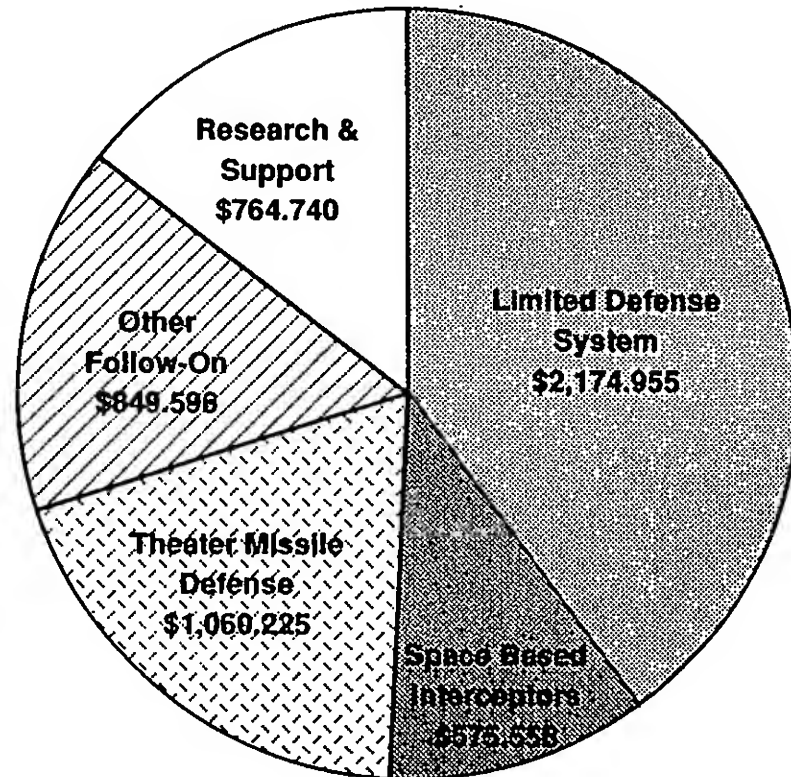
*\$s In Millions*

**FY 92 Appropriation**



**Total FY 92 \$4,141.601**

**FY 93 Budget Request**

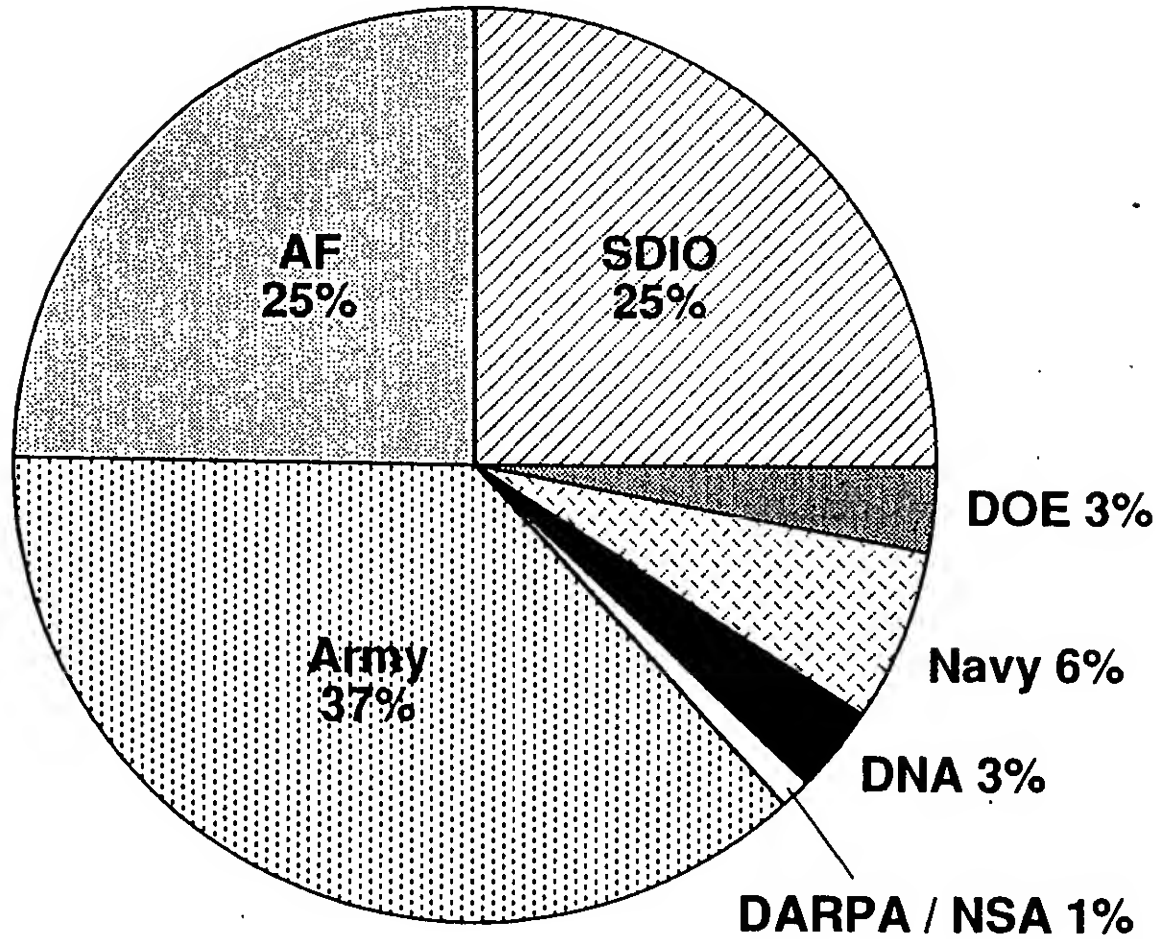


**Total FY 93 Request \$5,425.074**



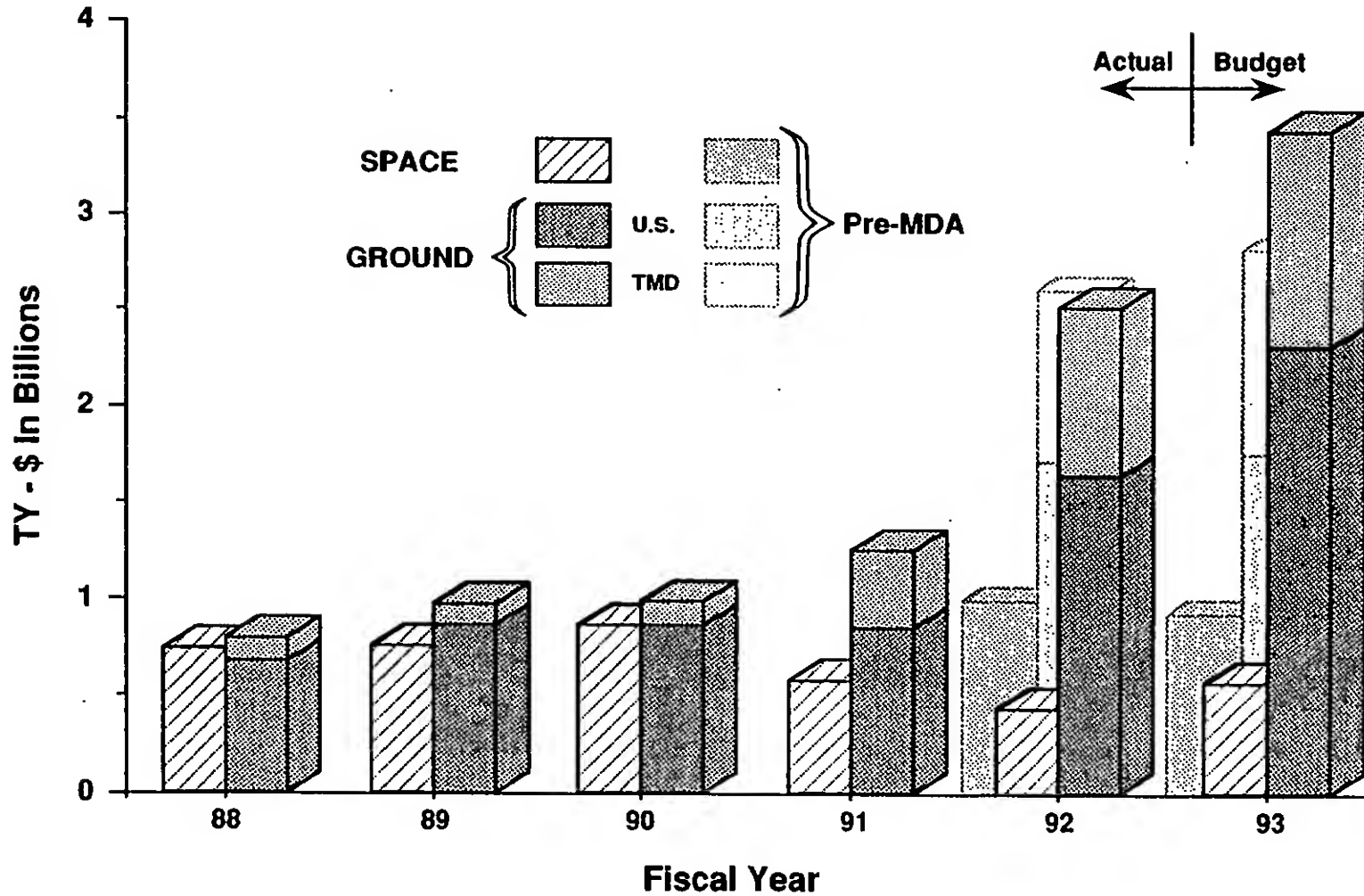
# STRATEGIC DEFENSE INITIATIVE BY EXECUTING AGENT FY 85 - 93

*Percentage*



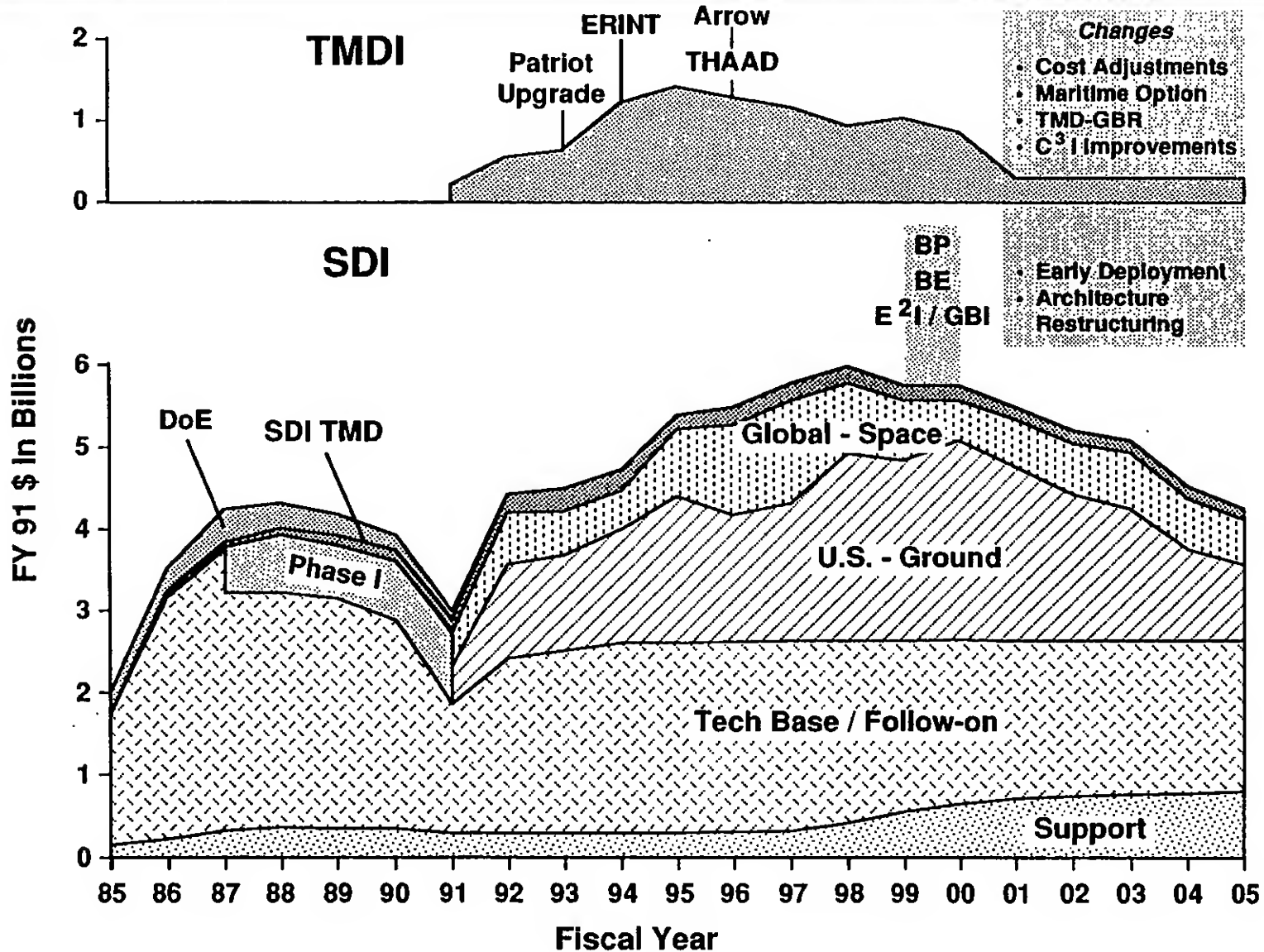


# SPACE - GROUND R&D INVESTMENTS





# BMD BUDGET EVOLUTION





## SUMMARY

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- **Threat**      - **Evolving, Increasingly Uncertain And Dangerous**
  
- **Mission**    - **Consistent With Presidential Refocus, Missile Defense Act, And Existing JCS Requirements**
  
- **Execution**   - **Users, Agents, SDIO Postured For Acquisition**  
  
                     - **Consensus On Early Deployment Of NMD And TMD**  
  
                     - **Continuing GMD Research / Focus Upon GPALS**
  
- **Resources**   - **Near Term Capability Is Top Budget Priority**  
  
                     - **Congressional Direction Requires Out Year Budget Adjustments**



# STRATEGIC DEFENSE INITIATIVE

## Advance Planning Briefing For Industry On Ballistic Missile Defense And Systems Architecture



2 MAR 92

**Dr. Edward Gerry**  
**Systems Architect**  
**Strategic Defense Initiative Organization**



# PROGRAM FOCUS

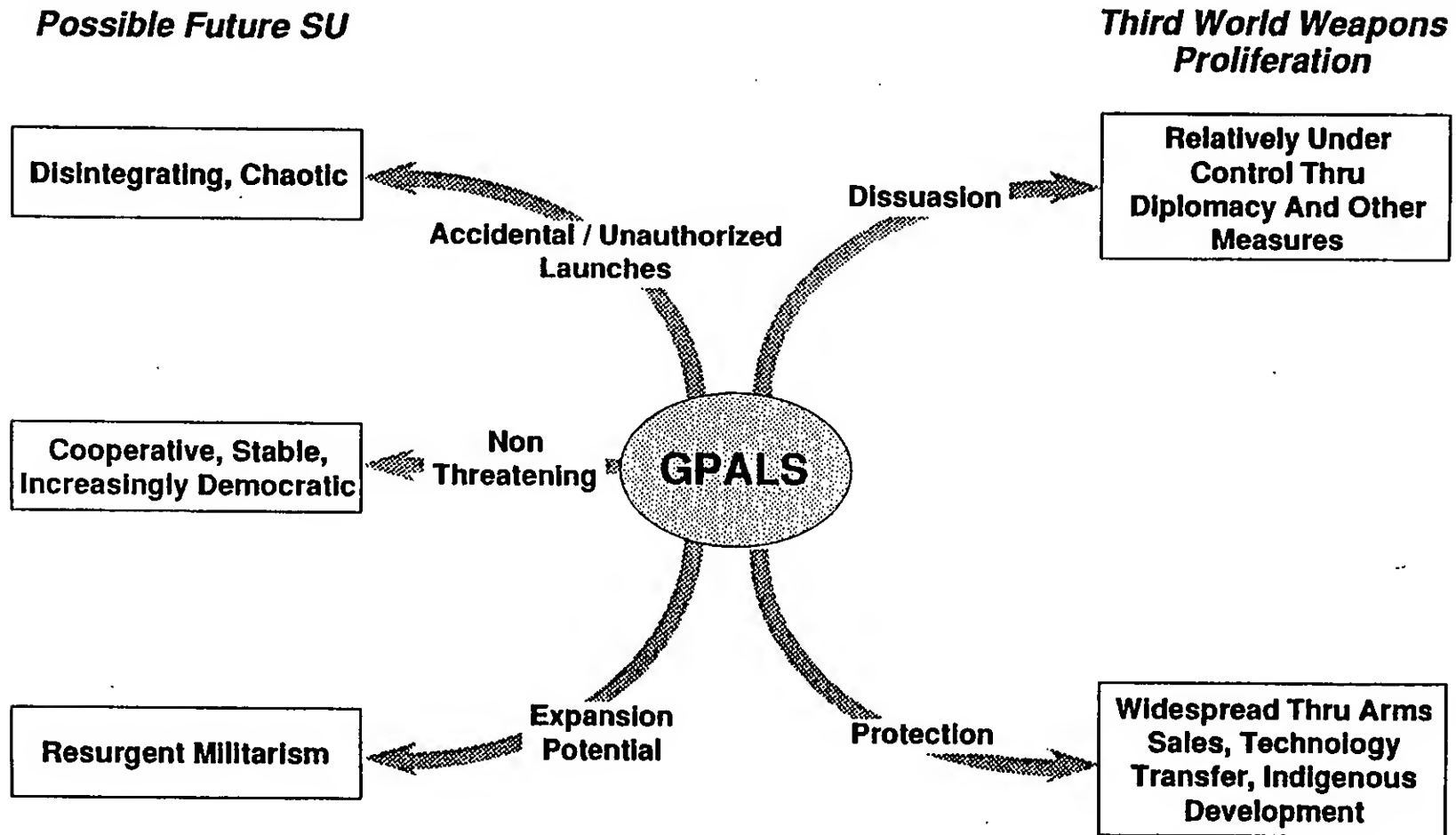
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## Objective

- **Protect Against**
  - **Ballistic Missile Attacks On U.S. Forces Overseas And U.S. Friends / Allies**
  - **Accidental, Unauthorized And / Or Limited Ballistic Missile Attacks On The United States**

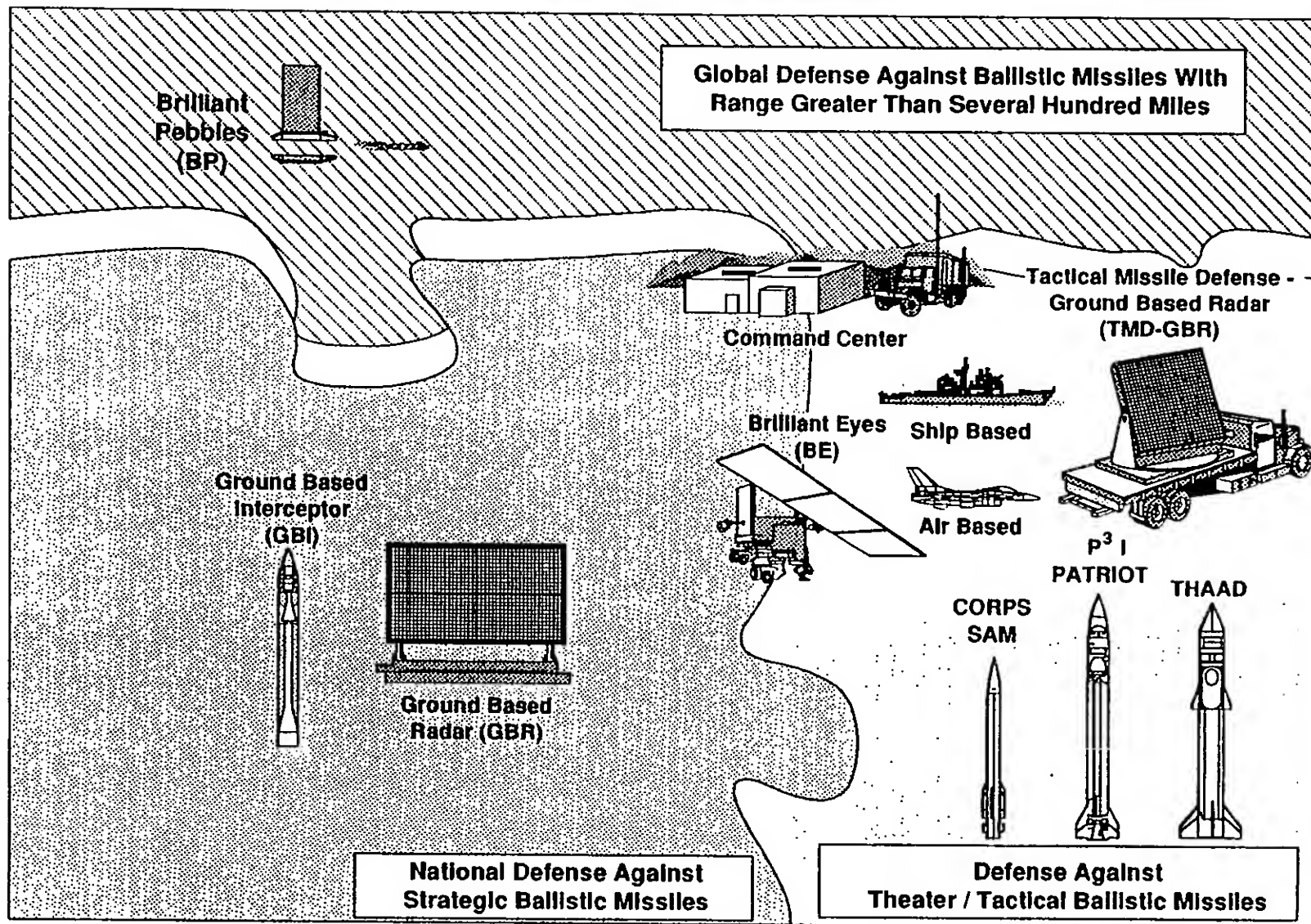


# DEALING WITH UNCERTAIN FUTURES





# GLOBAL PROTECTION AGAINST LIMITED STRIKES (GPALS)





# MISSILE DEFENSE ACT OF 1991

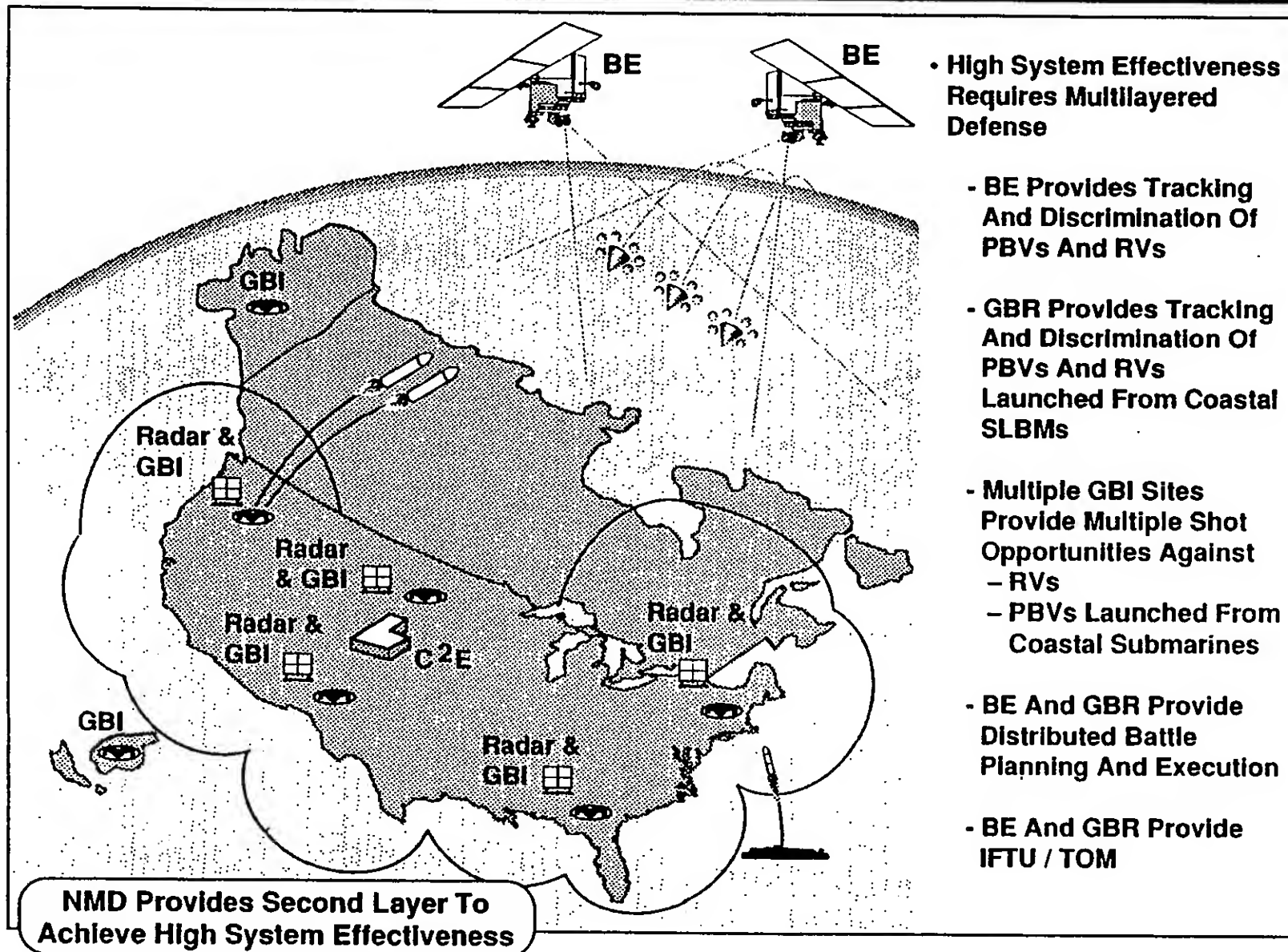
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## *Missile Defense Goal Of The United States*

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  - **Maintain Strategic Stability**
  - **Provide Highly Effective Theater Missile Defenses (TMDs) To Forward Deployed And Expeditionary Elements Of The Armed Forces Of The United States And To Friends And Allies Of The United States**



# NATIONAL MISSILE DEFENSE





# **1991 MISSILE DEFENSE ACT LIMITED DEFENSE SYSTEM**

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- **Design To Protect The United States Against Limited Ballistic Missile Threats**
  - **Accidental Or Unauthorized Launches**
  - **Third World Attacks**
- **Develop For Deployment, A Cost Effective, Operationally Effective, ABM Treaty Compliant, Antiballistic Missile System At A Single Site As The Initial Step Toward Deployment Of A Highly Effective Antiballistic Missile System**
- **By The Earliest Date Allowed By The Availability Of Appropriate Technology Or By FY 96**



# TOP LEVEL STRATEGY

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- **Deploy Initial Site As Soon As Possible As Called For In The MDA91 And Build On It**
  - **On The Path To Full Multisite NMD**
- **Maintain Options To Respond To Uncertain Futures With A Robust Technology Base Program**
- **Maintain Consistency With Evolving National And International Policies And Constraints**





# BASELINE PROGRAM

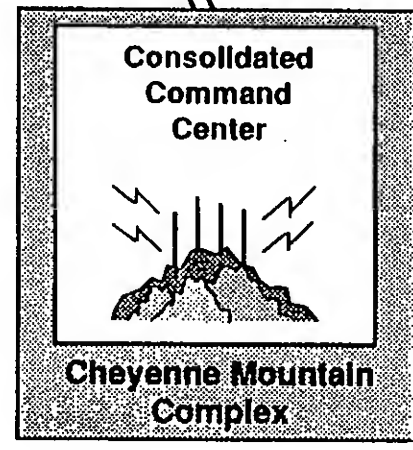
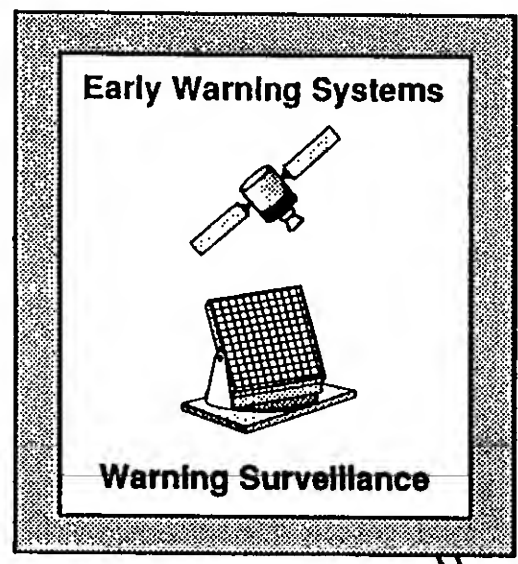
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- **CCE / BMC<sup>3</sup> Open Architecture Design For Full GPALS With First Site Components Operational To Support Initial Capability**
- **GBR And GBI Operational At First Site To Support Initial Capability**
- **Accelerated Deployments Of BE As Primary Midcourse Optical Sensor To Augment Initial Capability**
  - **Maximum Kinematic Footprint For GBI As Early As Possible**
- **GSTS Maintained As Backup Optical System As Hedge Against Failure Of Critical BE Technology Demonstrations**

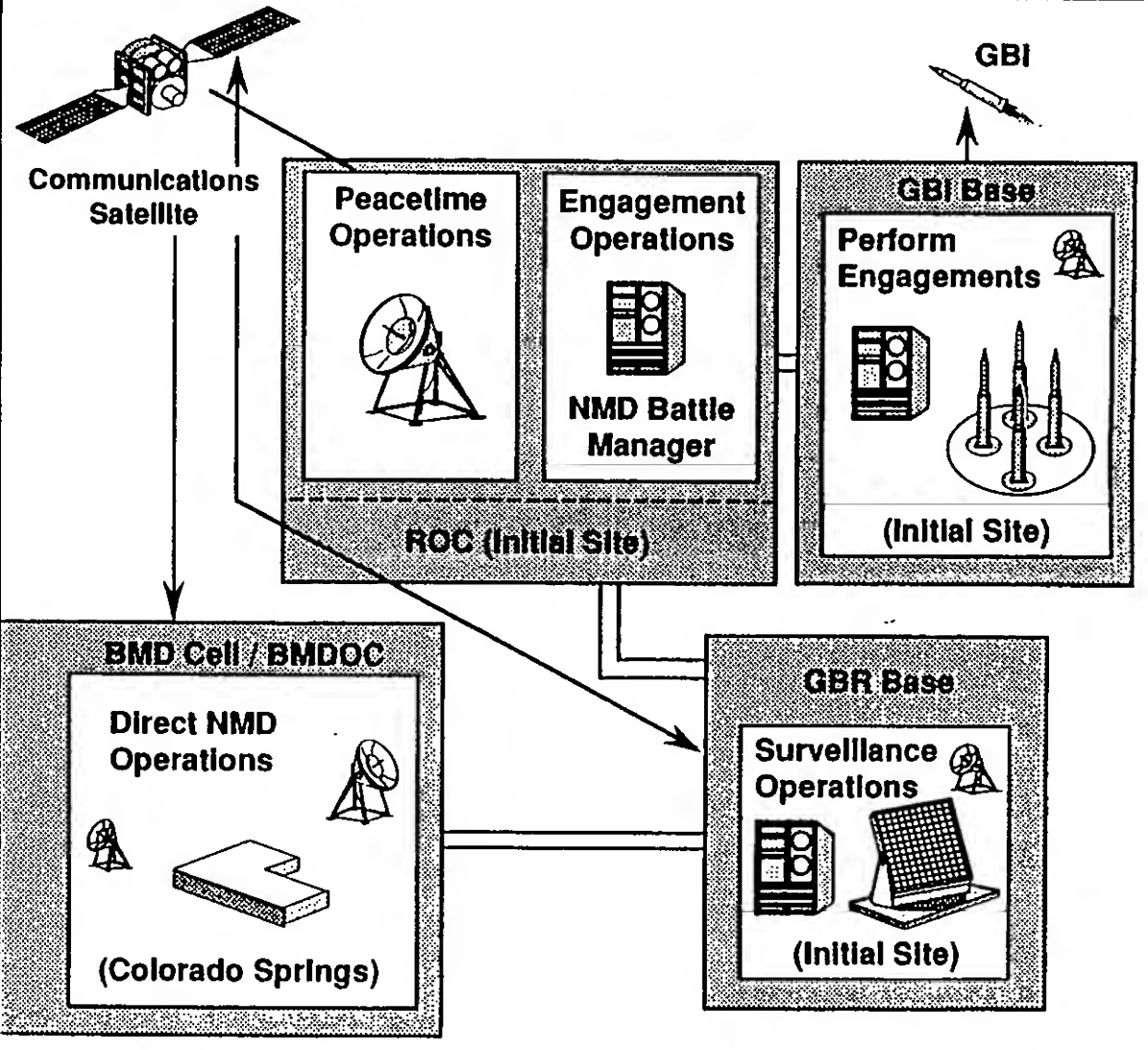


# INITIAL NMD BMC<sup>3</sup>

## Current Warning Architecture



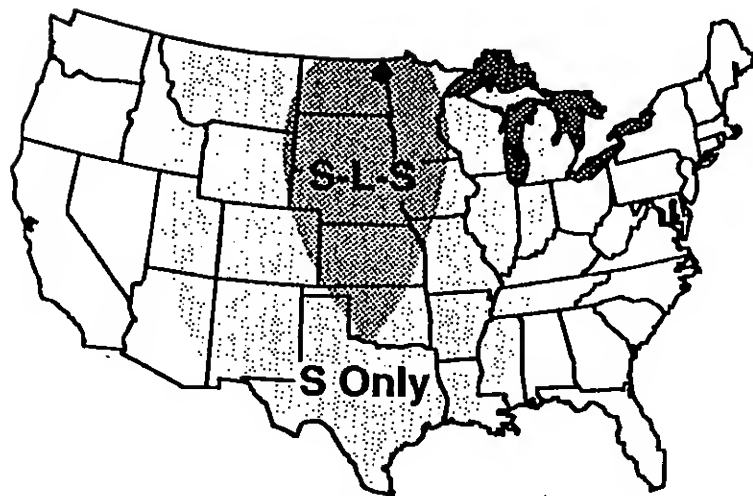
## Initial NMD Segment Architecture



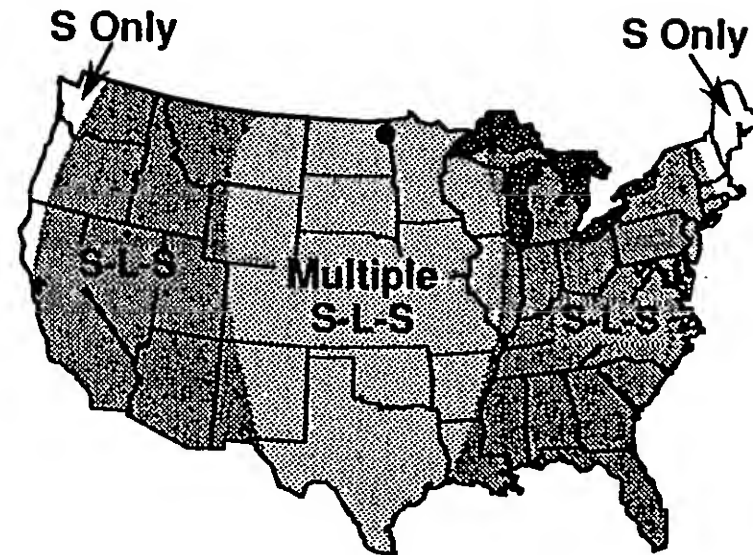


# COMPOSITE MULTI-THREAT DEFENSE COVERAGE

- Composite Threat
  - CSS-4 From China And Middle East
  - SS-18, SS-N-20 In Bastion, SS-24 From CIS
- Single Site At Grand Forks, ND For GBI And GBR
- GBI Fly Out 6.5 km / sec



**GBR Only**

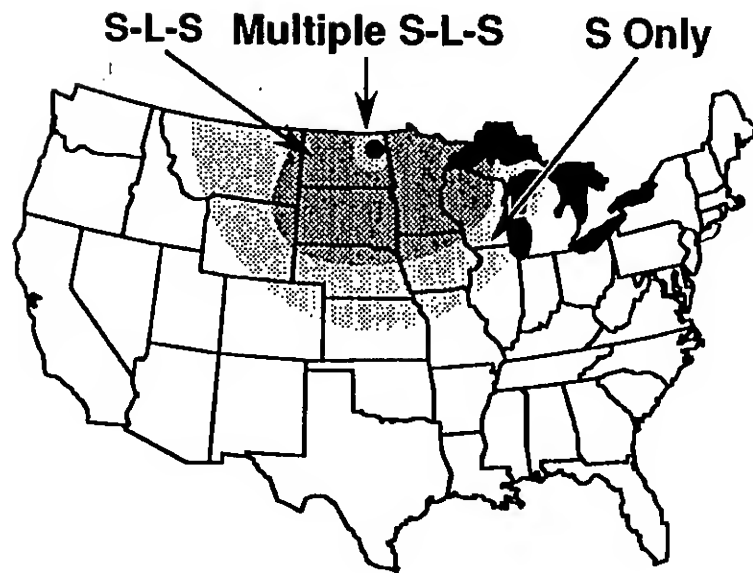


**BE And GBR**

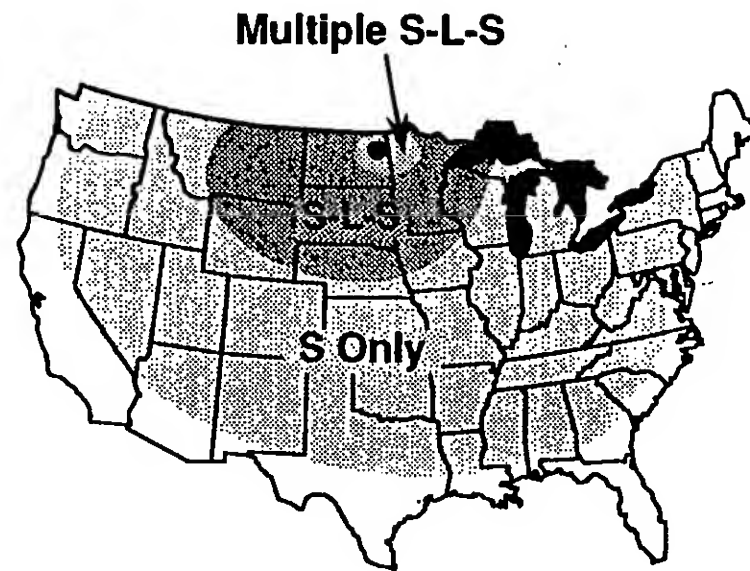


# DEFENSE COVERAGE

- SS-N-23 Out Of Bastion
  - 2,000 km From Coast
  - 24° Reentry Angle
- Single Site At Grand Forks, ND For GBR And GBI
- GBI Fly Out 6.5 km / sec



**GBR Only**

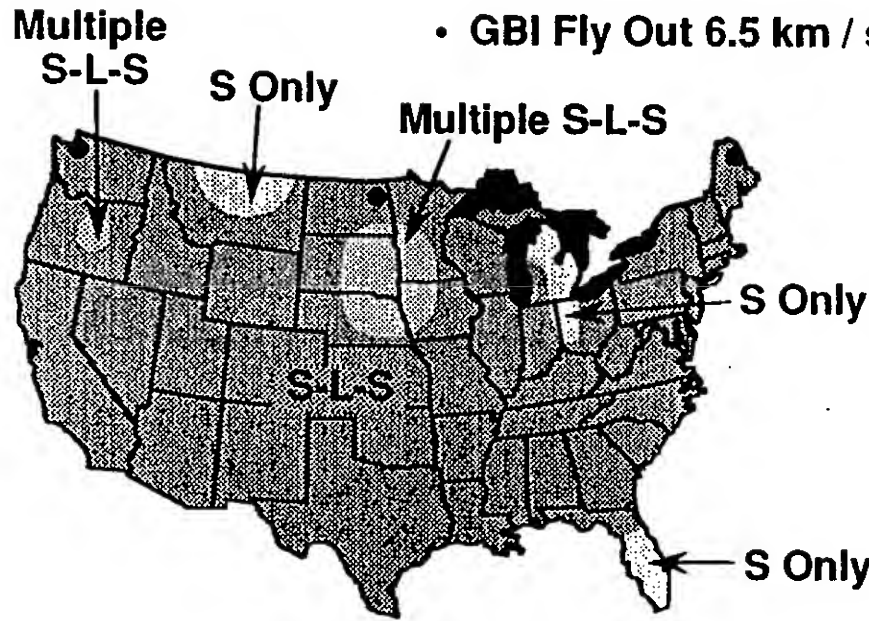


**BE And GBR**

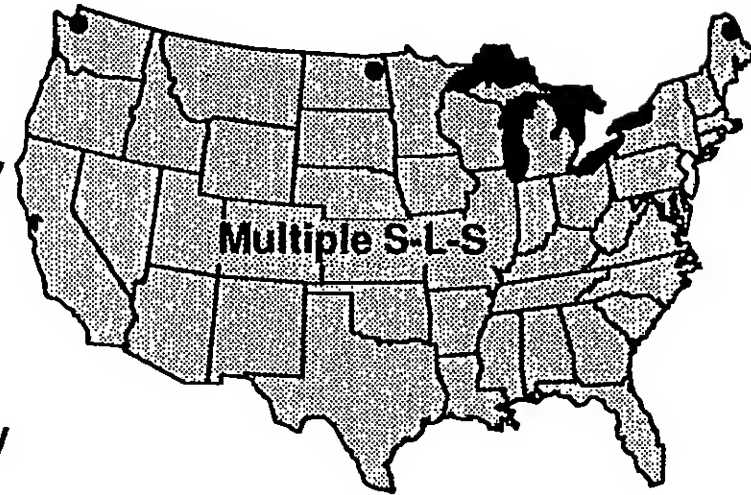


# COMPOSITE MULTI-THREAT DEFENSE COVERAGE

- Composite Threat
  - CSS-4 From China And Middle East
  - SS-18, SS-N-20 In Bastion, SS-24 From CIS
- Three Sites For GBR And GBI
  - NE
  - Grand Forks, ND
  - NW
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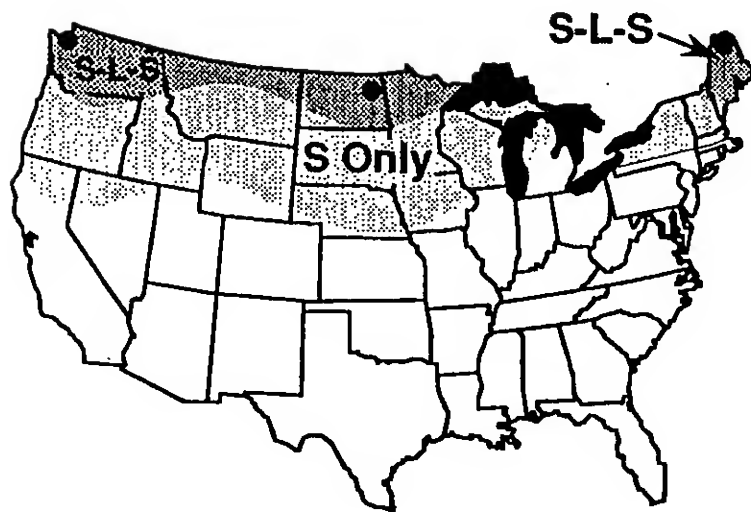


**BE And GBR**

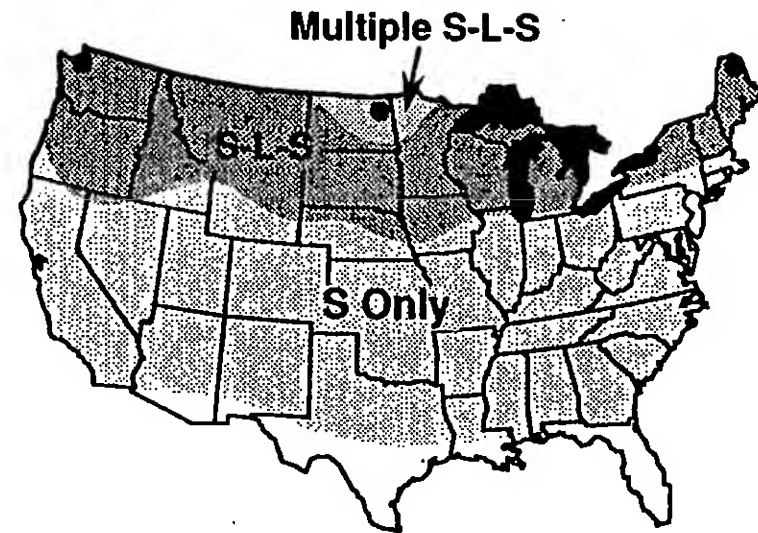


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**BE And GBR**



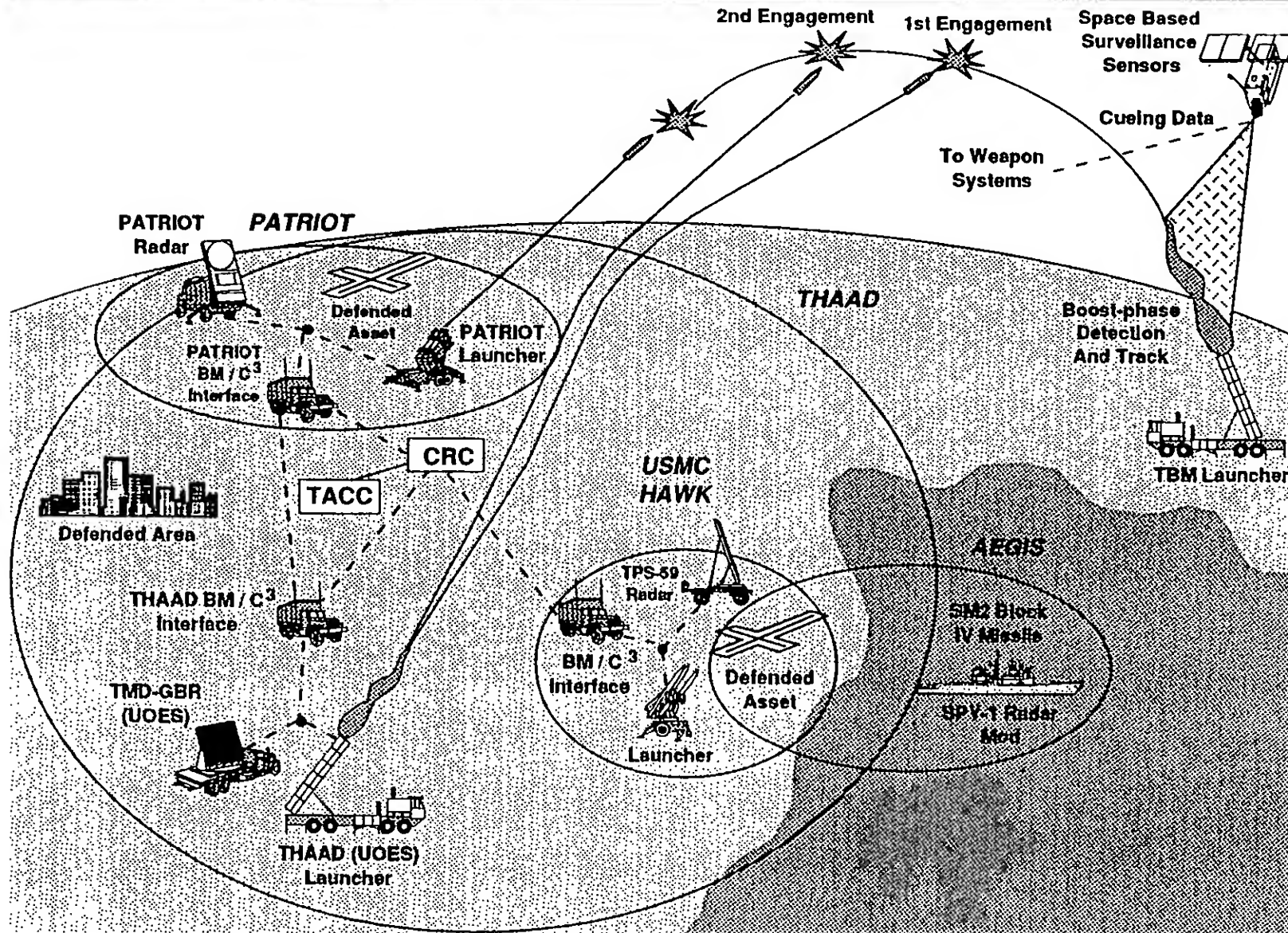
# JCS MISSION AREA NEEDS STATEMENT

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- **"Theater Missile" Includes Ballistic, Cruise, And Air-To-Surface Types**
- **Protect U.S. Forces, U.S. Allies And Other Important Countries Including Areas Of Vital Interest To The U.S., From Theater Missile Attack**
- **Conventional, Chemical, Biological And Nuclear Warheads**
- **Four Mission Areas**
- **Mix Of Land, Air, Sea, And Space Capabilities**
- **C<sup>3</sup>I Should Be Incorporated Into Existing Structures**
- **"Defense In Depth" With Multiple Shot Opportunities**
- **C-130 Deployable**



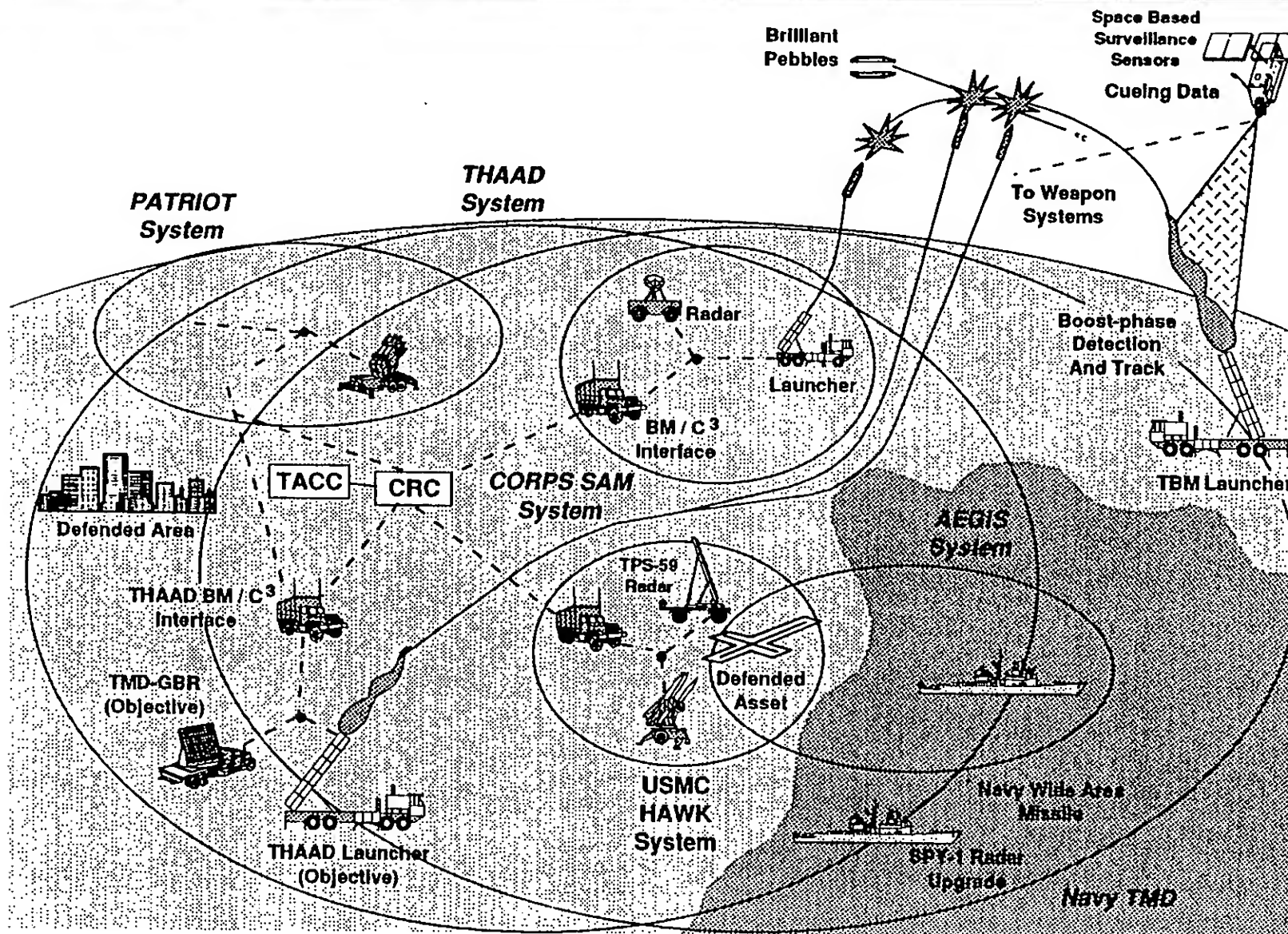
# NEAR TERM TBMD ACTIVE DEFENSE BASELINE ARCHITECTURE







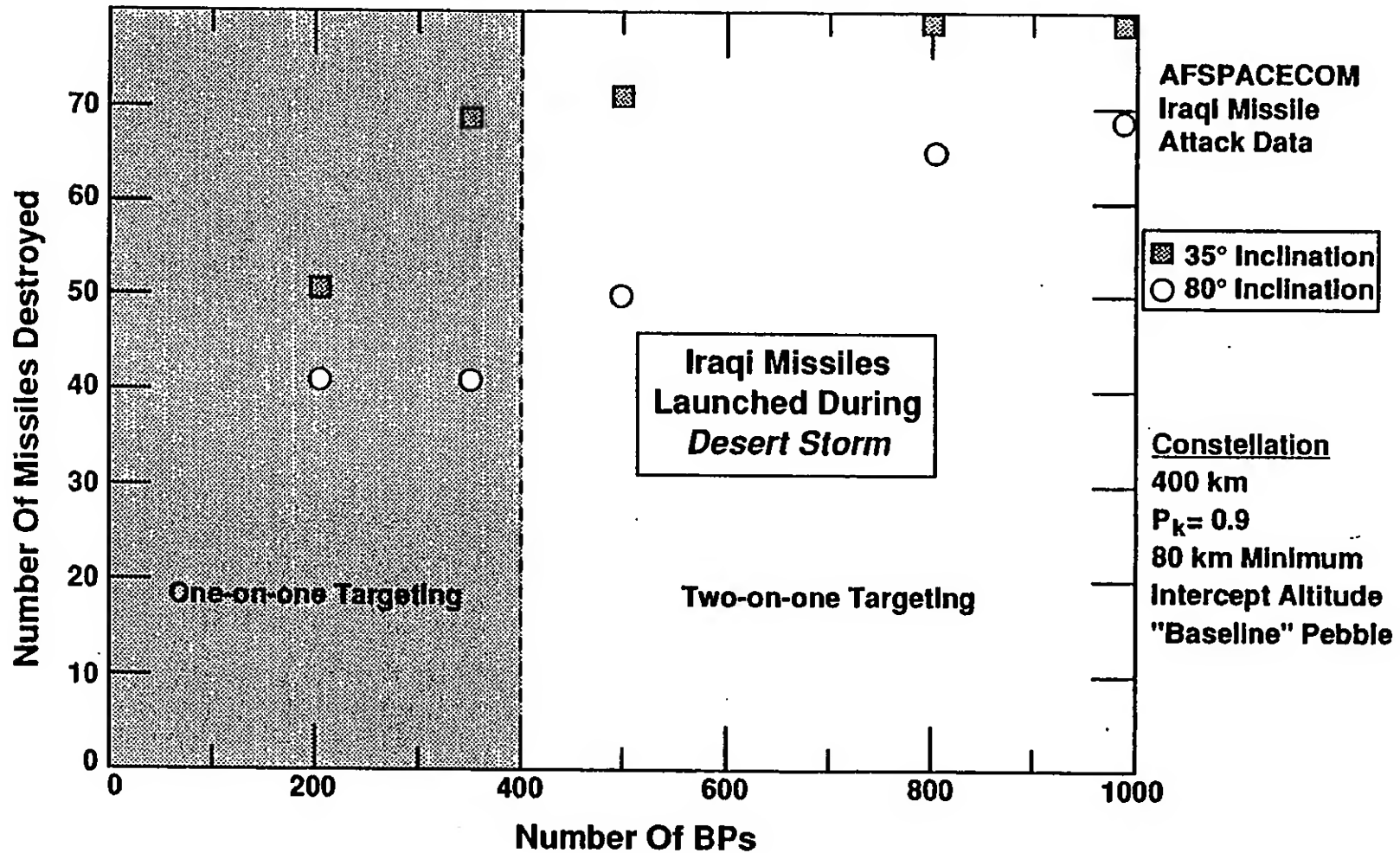
# FAR TERM TBMD ACTIVE DEFENSE BASELINE ARCHITECTURE





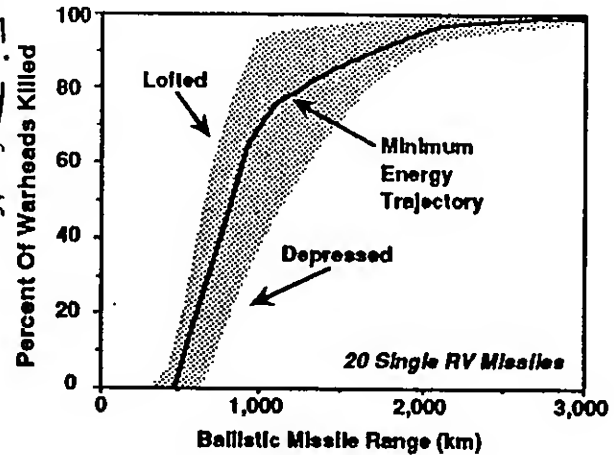
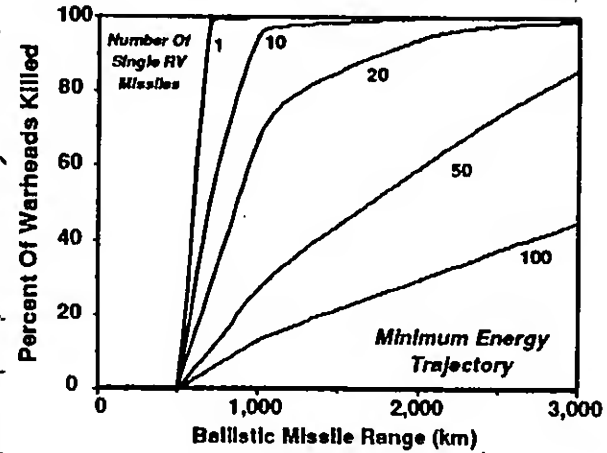
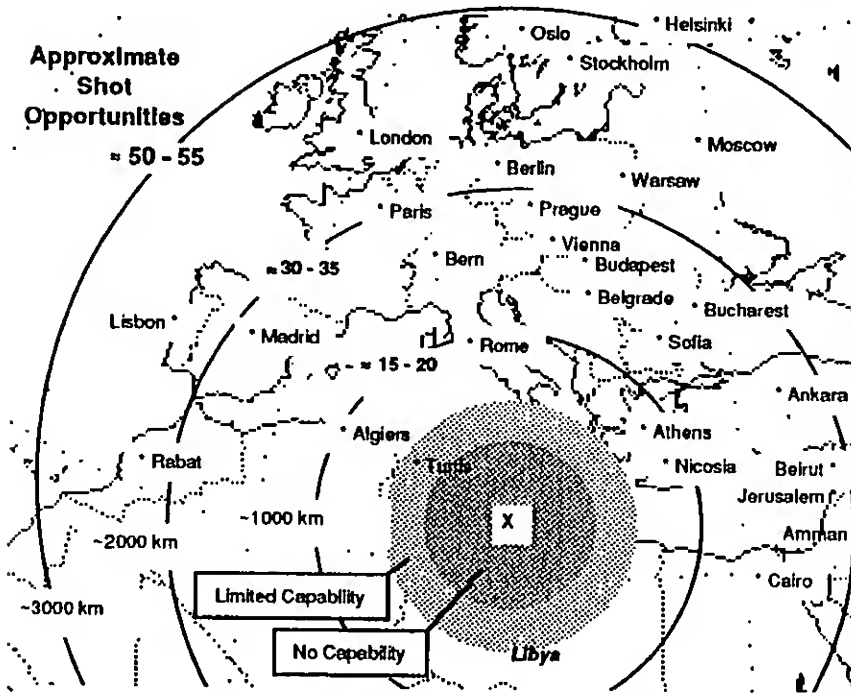
# HOW WOULD BRILLIANT PEBBLES HAVE PERFORMED AS THE SPACE-BASED SEGMENT IN GPALS AGAINST IRAQI MISSILES LAUNCHED DURING *DESERT STORM* ?

79 Missile Data Sets Available





# 1,000 BP CAPABILITY AGAINST HYPOTHETICAL ATTACK FROM LIBYA



- 1,000 BPs At Low Earth Orbit In A Typical Constellation
- Multiple Shots Available Against Simultaneous Launches
- Similar Capability vs ICBM / SLBM Attack

# **STRATEGIC DEFENSE INITIATIVE**

## **Advance Planning Briefing For Industry On Global Protection Against Limited Strikes (GPALS)**

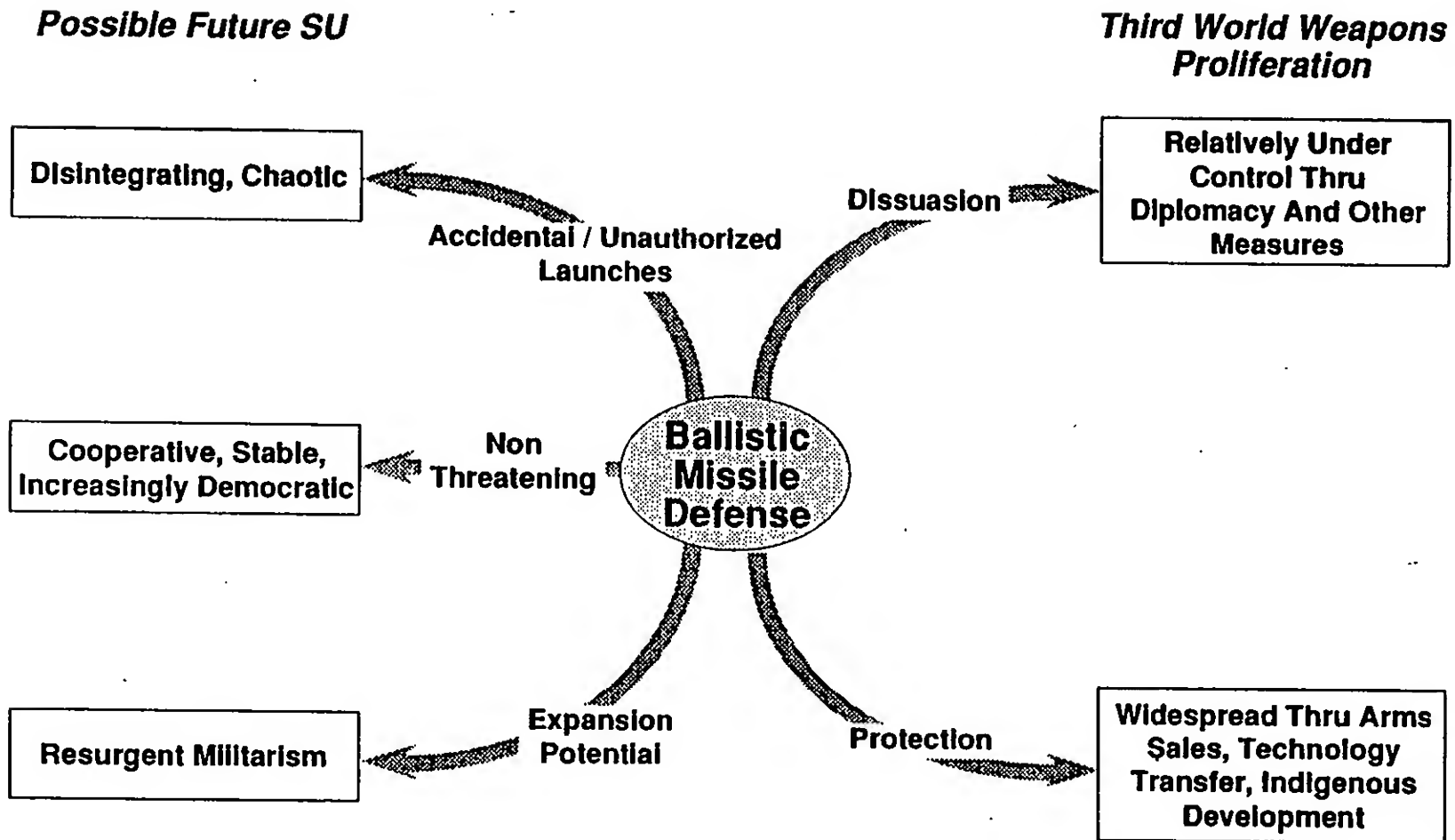


**2 MAR 92**

**Dr. James Carlson  
Deputy For Strategic Defense  
Strategic Defense Initiative Organization**

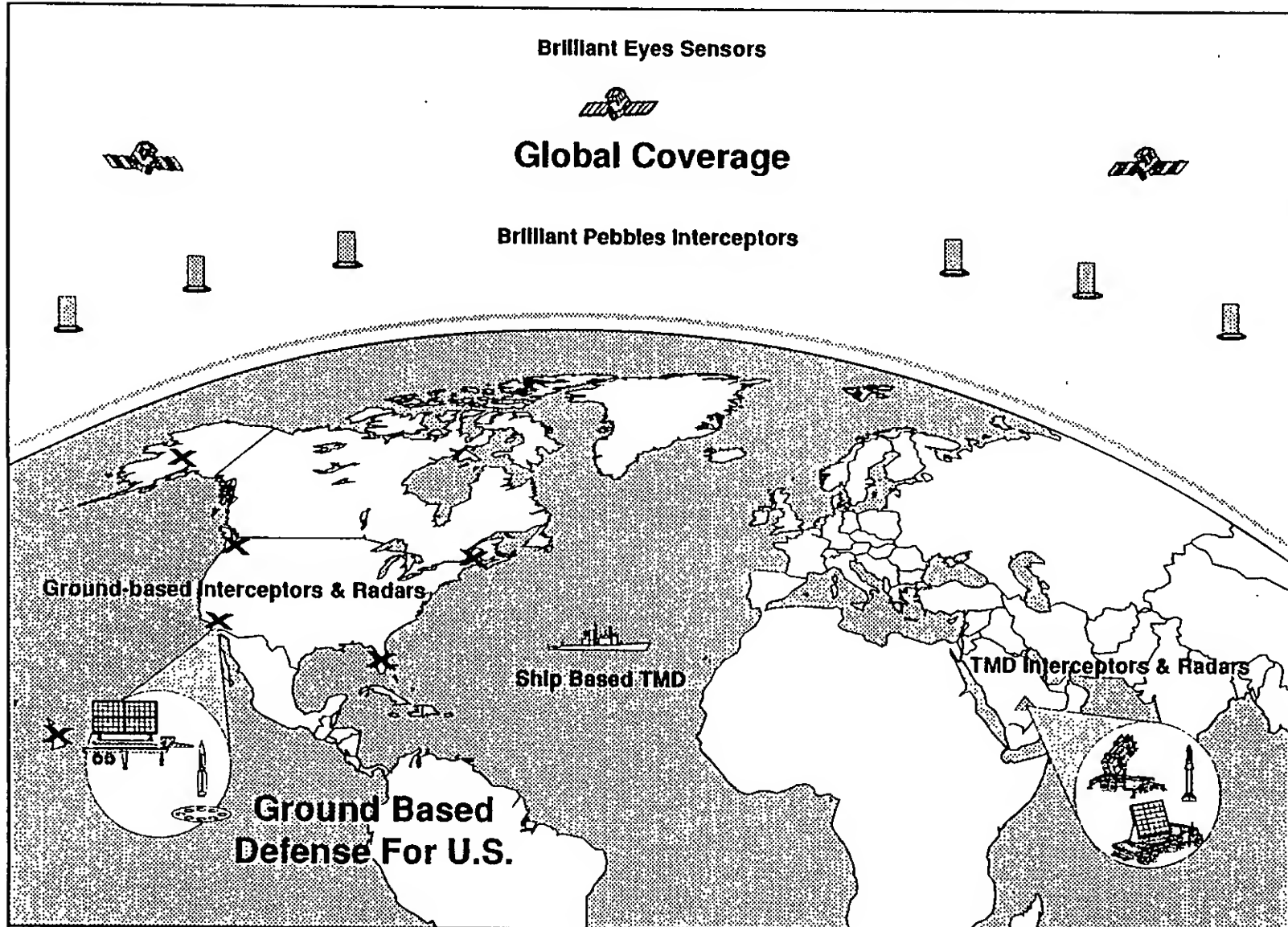


# DEALING WITH UNCERTAIN FUTURES





# GLOBAL PROTECTION AGAINST LIMITED STRIKES (GPALS)





# 1991 MISSILE DEFENSE ACT LIMITED DEFENSE SYSTEM

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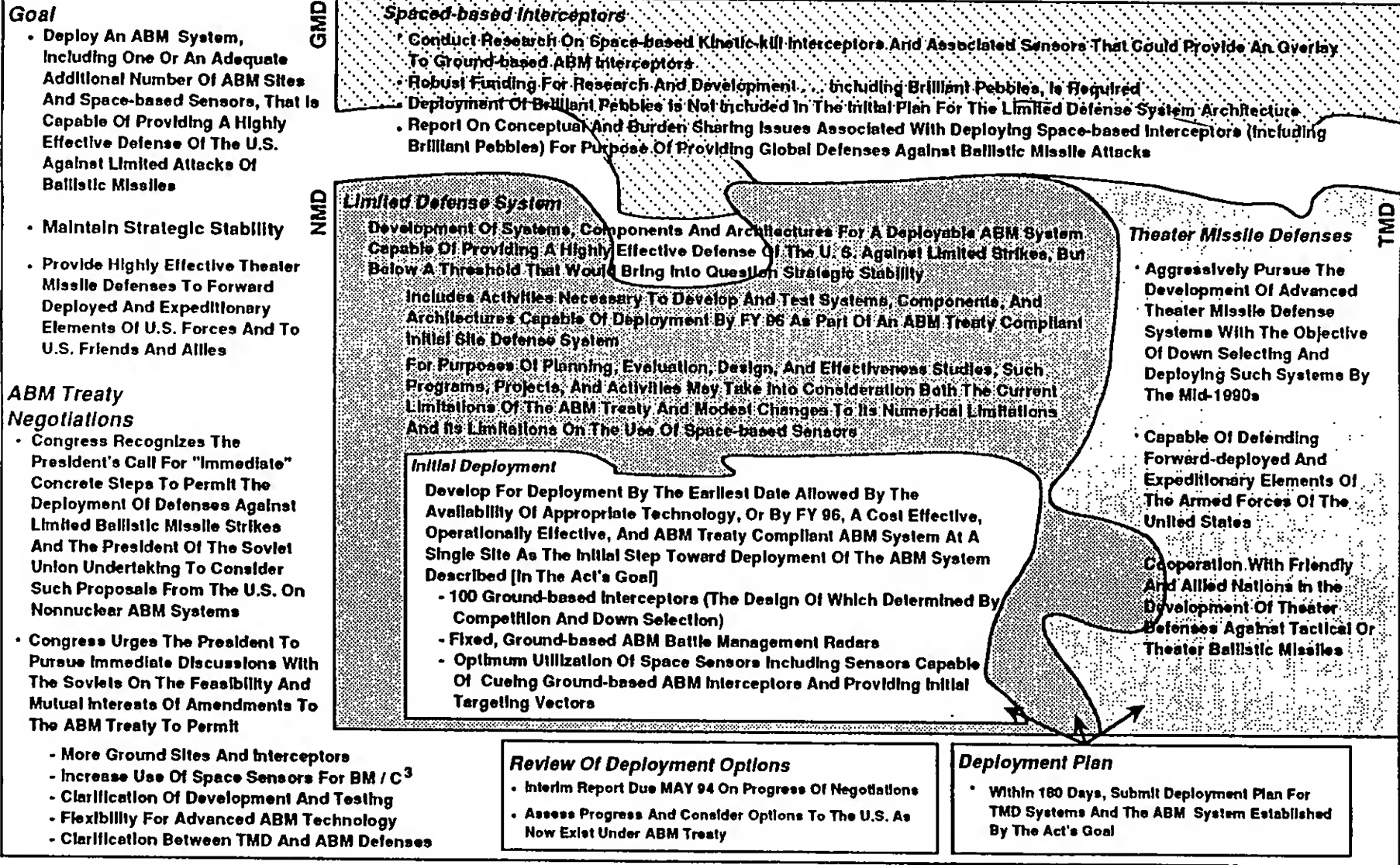
*(National System)*

- **Design To *Protect* The United States Against *Limited* Ballistic Missile Threats**
  - *Accidental Or Unauthorized Launches*
  - *Third World Attacks*
- **Develop For *Deployment A***
  - *Cost Effective*
  - *Operationally Effective*
  - *ABM Treaty Compliant*
- **Antiballistic Missile System At A *Single* Site As The *Initial Step* Toward *Deployment* Of A Highly Effective Antiballistic Missile System**
- **By The Earliest Date Allowed By The Availability Of Appropriate Technology Or By FY 96**





# MISSILE DEFENSE ACT OF 1991



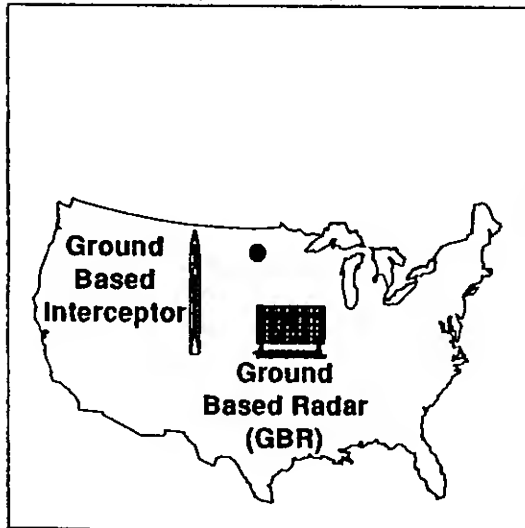




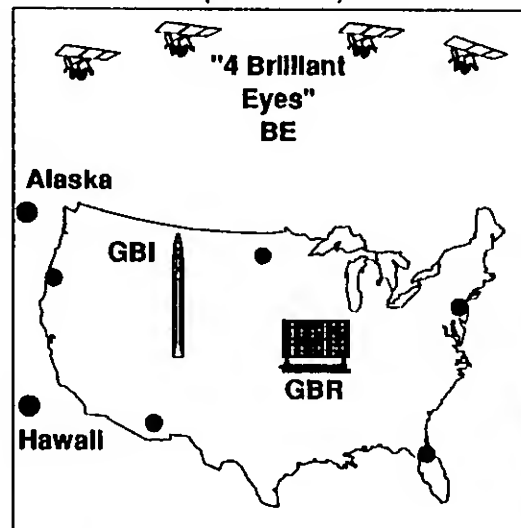
# DEFENSE ARCHITECTURE

- Goals:
- Highly Effective Defenses Of The U.S. Against Limited Attacks Of Ballistic Missiles — Consistent With Strategic Stability
  - Highly Effective Theater Missile Defenses For Forward Deployed And Expeditionary U.S. Forces, Friends And Allies

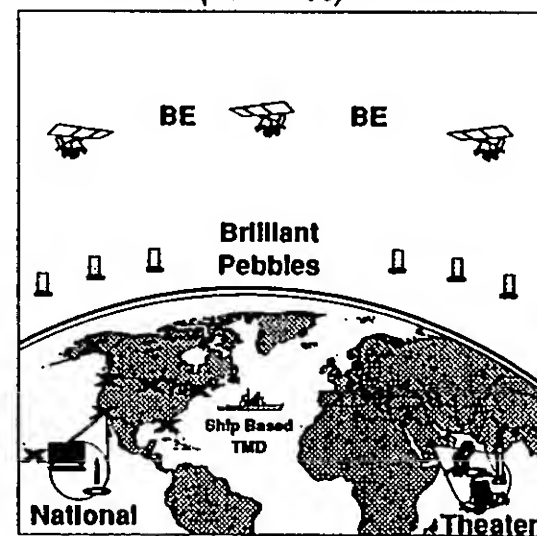
*Initial Site Defense System  
(FY 96 - 97)*



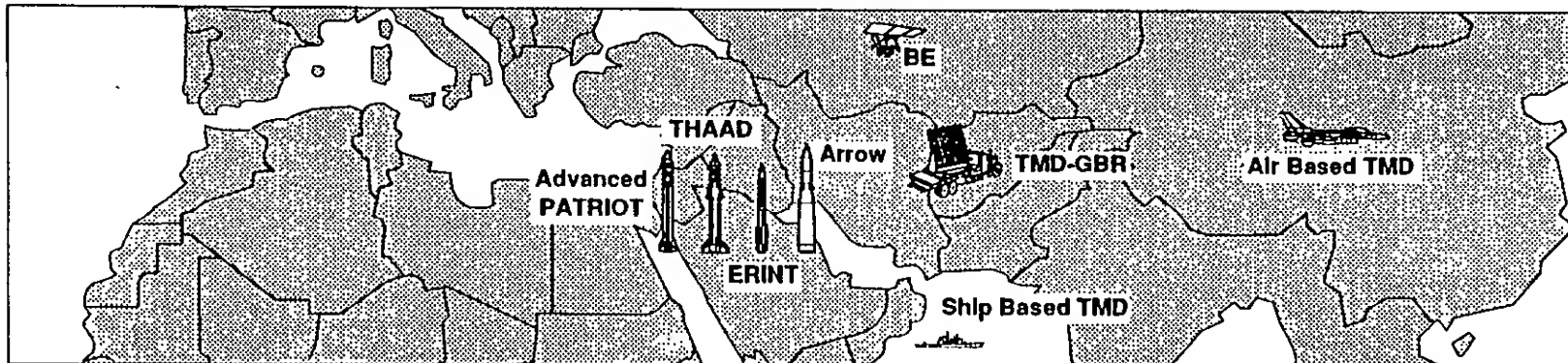
*Limited Defense System  
(FY 98 - 02)*



*With Space Based Interceptors  
(FY 00 - 03)*



*Theater Missile Defense (IMD) (FY 92 - 05)*





# 180-DAY REPORT PLAN

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- **Two Teams Performing Up Front Studies**
  - TMD, Led By MG O'Neill
  - U.S. Homeland Defense, Led By Dr. Gerry
  
- **Results To Be Reviewed By SDI System Design Board Prior To SDIO Recommendations For FY 94-99 POM**
  
- **Schedule**
  - Finalize Approach By April 1992 POM Submission
  - Submit Draft Of 180-Day Report To SECDEF By May 1992
  - Due To Congress June 1992



# GPALS HIERARCHY

(X) = MDAP Location

System - Level 1

GPALS System / BMC<sup>3</sup> ①

Segment - Level 2

NMD ②

GMD ③

TMD

(Level 2.5)

UTTMD ④

Element - Level 3

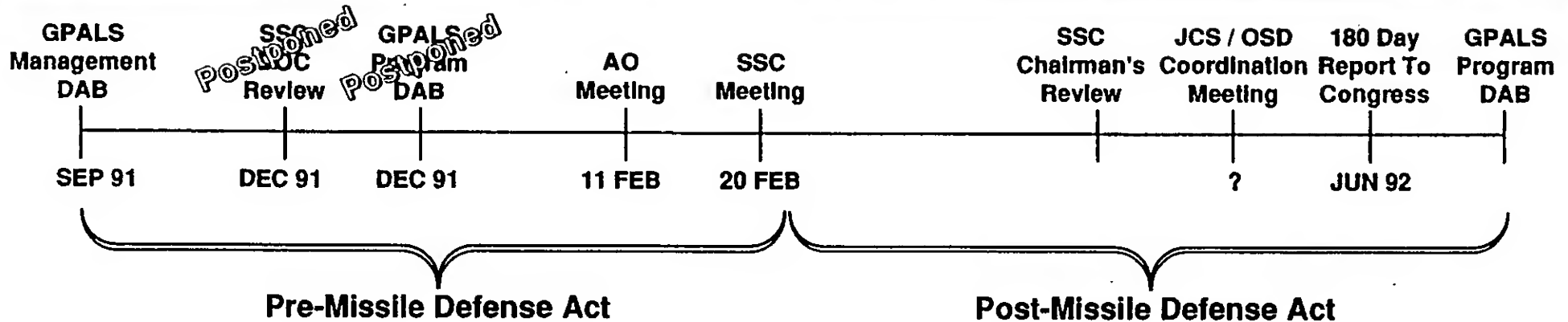
GBI  
GSTS  
GBR-T  
BE

THAAD  
BP  
(Air Force)  
(Navy)  
TMD-GBR  
CORPS SAM ⑤  
PATRIOT ⑥

GPALS System / BMC<sup>3</sup> MDAP Tells  
The Whole GPALS Story



# SDIO SSC / DAB STRATEGY



## Objectives February 1992 SSC

- Based On "Previous World"  
(Process Initiated February 1991 With Element CARD Tasking)
  - Approve Baseline Approach
  - Discuss Plan To Get To "Spring DAB"
  - Conclude Baseline Documentation Process
  - Close Out 10 DEC 91 SSC Issues

## Objectives Summer GPALS DAB

- Based On Missile Defense Act Of 1991
  - Review GPALS Architectural And Acquisition Strategy
  - Approve GPALS MDAP Baselines And Initial Element PPCs
  - Approve MDAP Cost Estimates
  - Approve DAB Documentation Required By White Paper



# **FY 92 MAJOR CONTRACTING ACTIVITIES**

---

- **Upper Tier Theater Missile Defense Concept Exploration**
- **Ground Based Radar**
- **Brilliant Eyes**
- **Ground Based Interceptor**
- **Numerous Supporting Technology Programs**



# OPTIONS ASSESSMENT FOR GBI

---

- **GBI Must Meet NMD Segment Effectivity Performance Requirements**
- **Deployable Exo Interceptor At GF, Upgradable To Full Operational Capability Later**
- **GBI / NMD Options Development**
  - **Describe Options For Exo GBI In FY 97**
    - **Development**
    - **Fabrication**
    - **Test**
    - **Integration**
    - **Production**
    - **Deployment**
  - **Options That Improve NMD Requirements Documents**
    - **Industry Perspective On Critical Requirements**
    - **Allocations Between GBI And NMD Segment**
  - **Options For GBI Performance Enhancement**
    - **Risk Reduction**
    - **Approach For Tech Infusion To Meet Full Operational Capability**
    - **Militarization**



# GBI OPTIONS ASSESSMENT

Activity	FY 92								FY 93			
	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
Release CBD Notice	▲ <sup>19</sup>											
Release Options RFP		▲ <sup>6</sup>										
Industry Proposal Prep		▲ <sup>6</sup>	▲ <sup>3</sup>									
Evaluate / Negotiate			▲ <sup>3</sup> ▲ <sup>17</sup>									
Award Options Contract			▲ <sup>21</sup>									
Options Assessment Phase			▲ <sup>21</sup>	IPR	IPR		▲ <sup>21</sup>					
Release Draft GBI RFP				▲								
OSD Review						▲ <sup>20</sup>	▲ <sup>21</sup>					
Release GBI RFP							▲ <sup>4</sup>					
Industry Proposal Prep							▲ <sup>4</sup>		▲ <sup>20</sup>			
Evaluate Proposal									▲ <sup>20</sup>			
Negotiate											▲ <sup>31</sup>	
Award GBI Contract											▲ <sup>31</sup>	▲ <sup>23</sup>



# GLOBAL PROTECTION AGAINST LIMITED STRIKES SYSTEM

---

- **GPALS Represents A New Capability**
  - No Existing System
  - Must Be Viewed As An Entity
- **GPALS Architecture Must Be Capable Of Evolving Over Time**
  - To Accommodate Changing Geopolitical Context
  - Acquisition Strategy Will Evolve With Architecture
- **Importance Of Urgency Has Been Made Clear By Secretary Of Defense And The Congress**
  - Will Not Occur With A "Business As Usual" Approach

**End Points Of A New Capability Should Not Be Predetermined Up Front**



# STRATEGIC DEFENSE INITIATIVE

## System Engineering



2 MAR 92

COL W. Hecker, USA  
Strategic Defense Initiative Organization



# OUTLINE

---

- **System Engineering Approach**
- **User Interface**
- **Requirements Traceability**
- **Performance Assessment**
- **System Risk Management**
- **GPALS Integration**



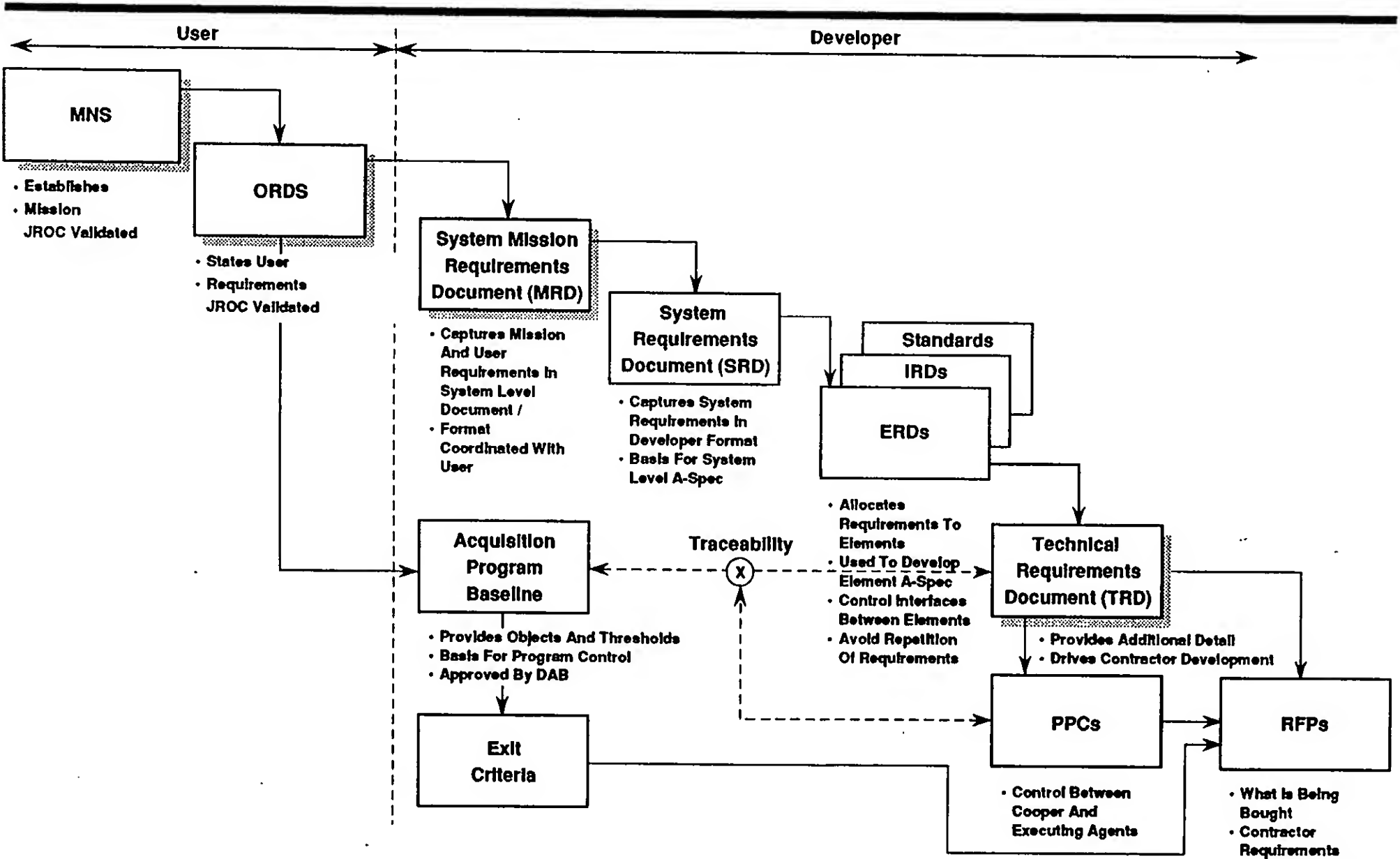
# SYSTEMS ENGINEERING APPROACH

---

- **Strong, Centralized SE&I Activity**
  - **Single Contractor**
  - **Central Operating Facility And Multiple Field Sites**  
**Enable Close Coupling With User / Service Activities**
  - **Focused Support To Segment / MDAP Managers**
  - **GPALS System, BMC<sup>3</sup>, NMD, GMD, TMD**
- **Key Responsibilities**
  - **Engineering Interface With User (USSPACECOM)**
  - **GPALS System Definition / Requirements Allocation**
  - **End-To-End Performance Assessment**
  - **GPALS Integration**

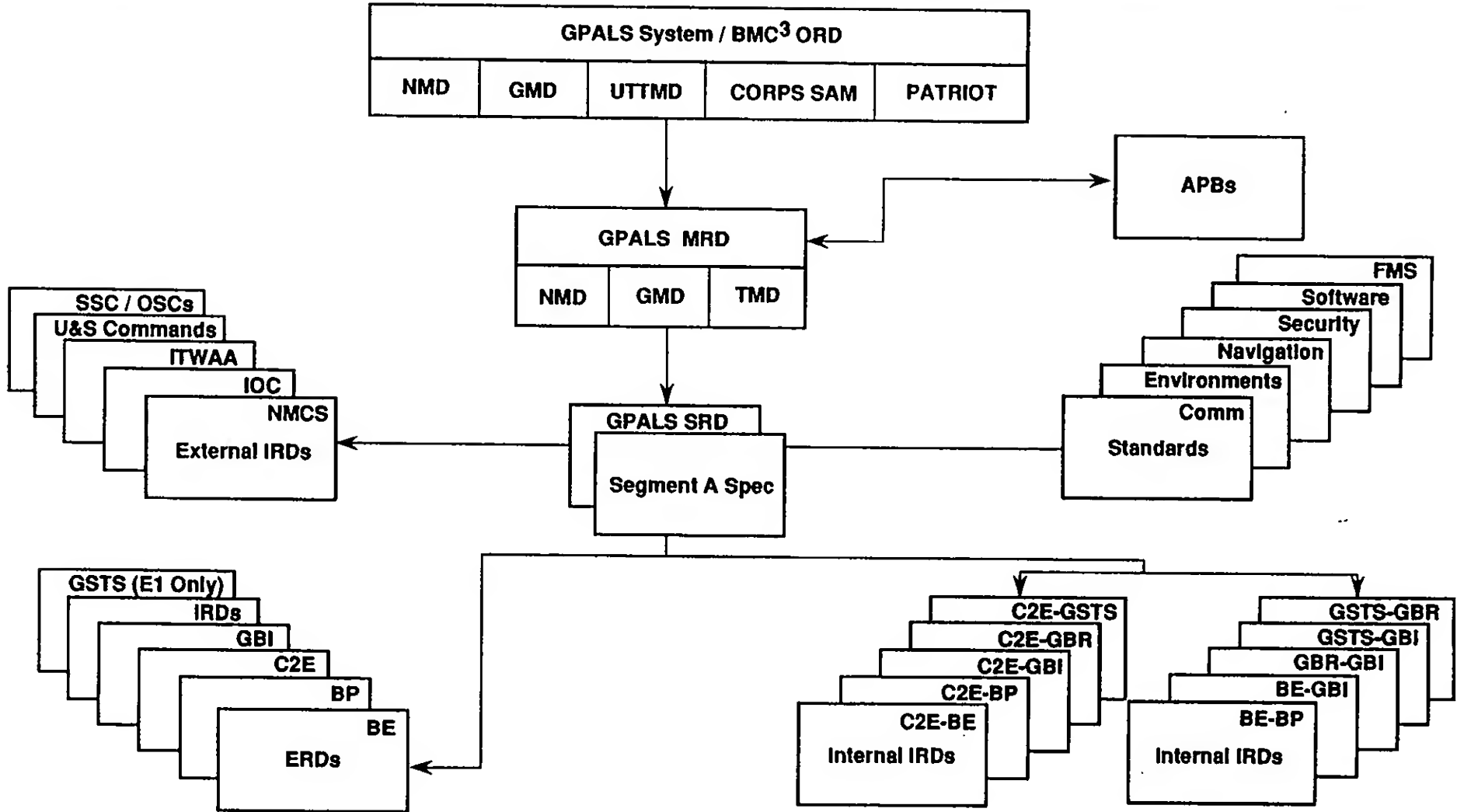


# USER INTERFACE (REQUIREMENTS FLOW DOWN)





# GPALS REQUIREMENTS DOCUMENT TRACEABILITY





# END-TO-END PERFORMANCE ASSESSMENT

---

- **System Effectiveness Is Iterated Using A Series Of Performance / Cost Trade-offs**
  - **At Each Succeeding Level Of Decomposition, Until**
    - **The Mission Requirements Are Met**
    - **System Objectives Are Satisfied**
    - **Most Cost Effective System Design Has Been Achieved**
- **Effectiveness Trades Include Balancing**
  - **Tier - Tier Performance**
  - **Sensor vs Weapon Performance**
  - **Individual Platform Performance vs Inventory**
  - **Inventories vs Location (Basing)**
- **Multiple Tier Concept Provides Flexibility To Balance The System To Meet The Mission Requirement**



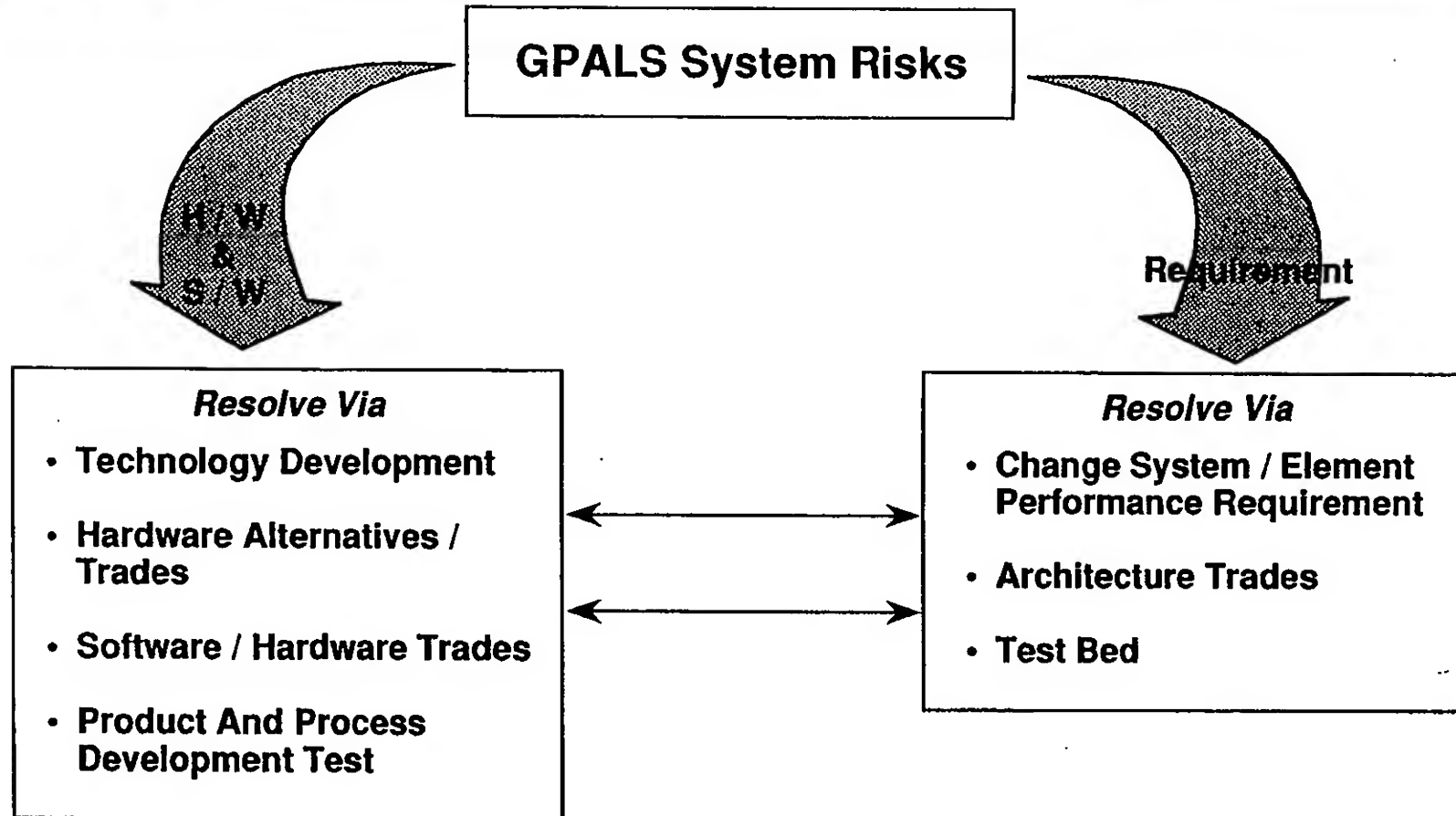
# SYSTEM RISK MANAGEMENT

---

- **GPALS Risk Management Program Constitutes**
  - **Competitive Acquisition Strategies**
  - **Technology Back-up Programs**
  - **Test, Evaluation And Validation Activities**
- **System Test Plan Focuses And Integrates Test Beds, Simulators, Elements And Technology Programs To Resolve Critical Performance Issues**
- **Interactive Cycle Of Test Bed Confidence Building Establishes The Basis For Integrated System Level Test And Demonstration**
- **The Hierarchy Of Test Beds Provides For Rigorous Validation Of Test Results Under Controlled Test Conditions**



# GPALS RISK ABATEMENT PROCESS

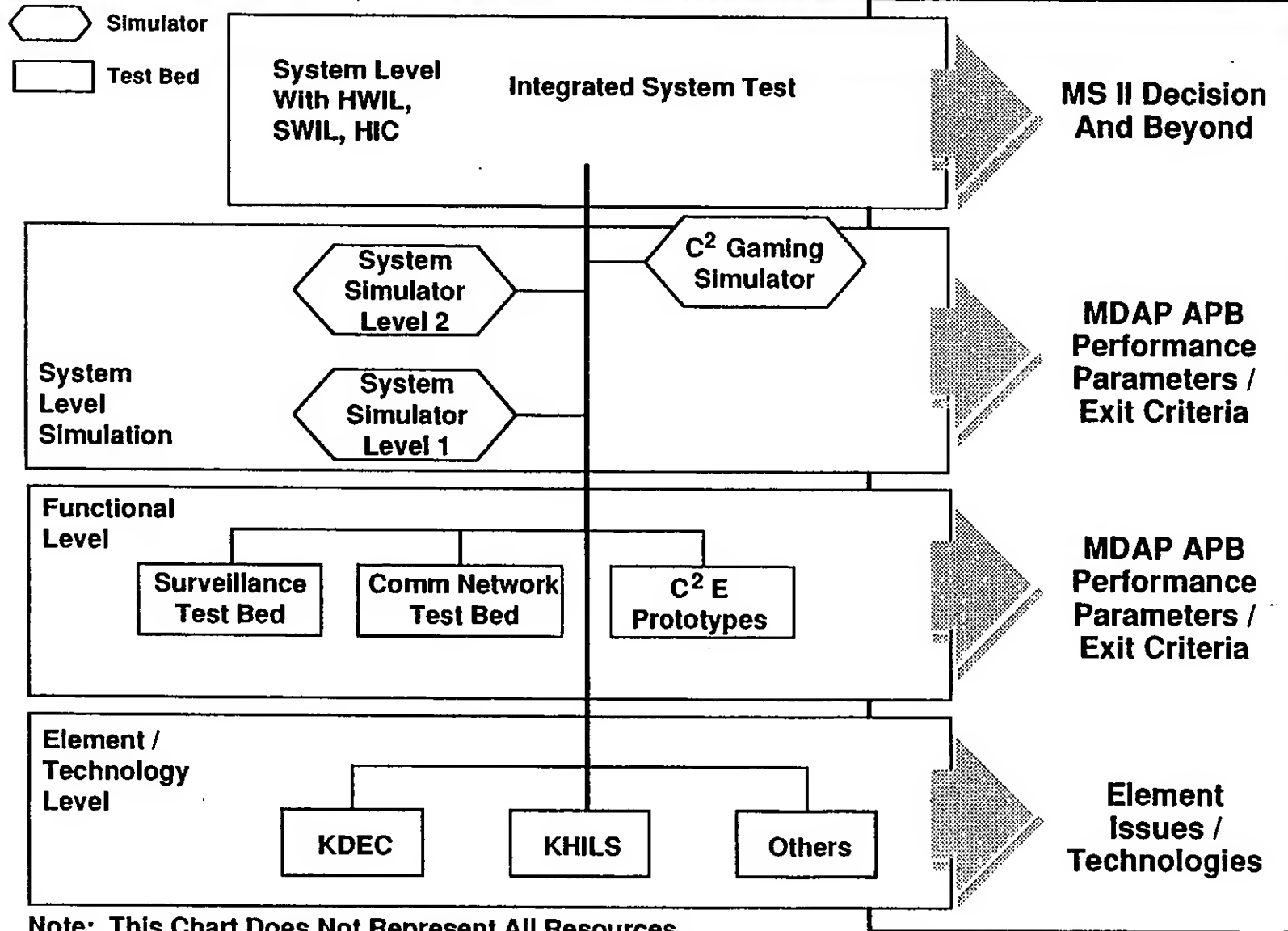


**GPALS Risk Management Process Resolves Risk Issues In Systematic Fashion**





# TOOLS AVAILABLE TO SUPPORT GPALS SYSTEM



# STRATEGIC DEFENSE INITIATIVE

## Brilliant Pebbles Advance Planning Briefing For Industry



2-3 MAR 92

**Lt Col Bill Rohlman, USAF**  
**Deputy Director, Global Defense Segment Directorate**  
**Strategic Defense Initiative Organization**



# AGENDA

---

- ➔ • **Space Based Interceptor Evolution**
  - **Acquisition Strategy**
  - **Test Program**
  - **Programmatics**
  - **Congressional Issues / Treaty Compliance**
  - **Summary**



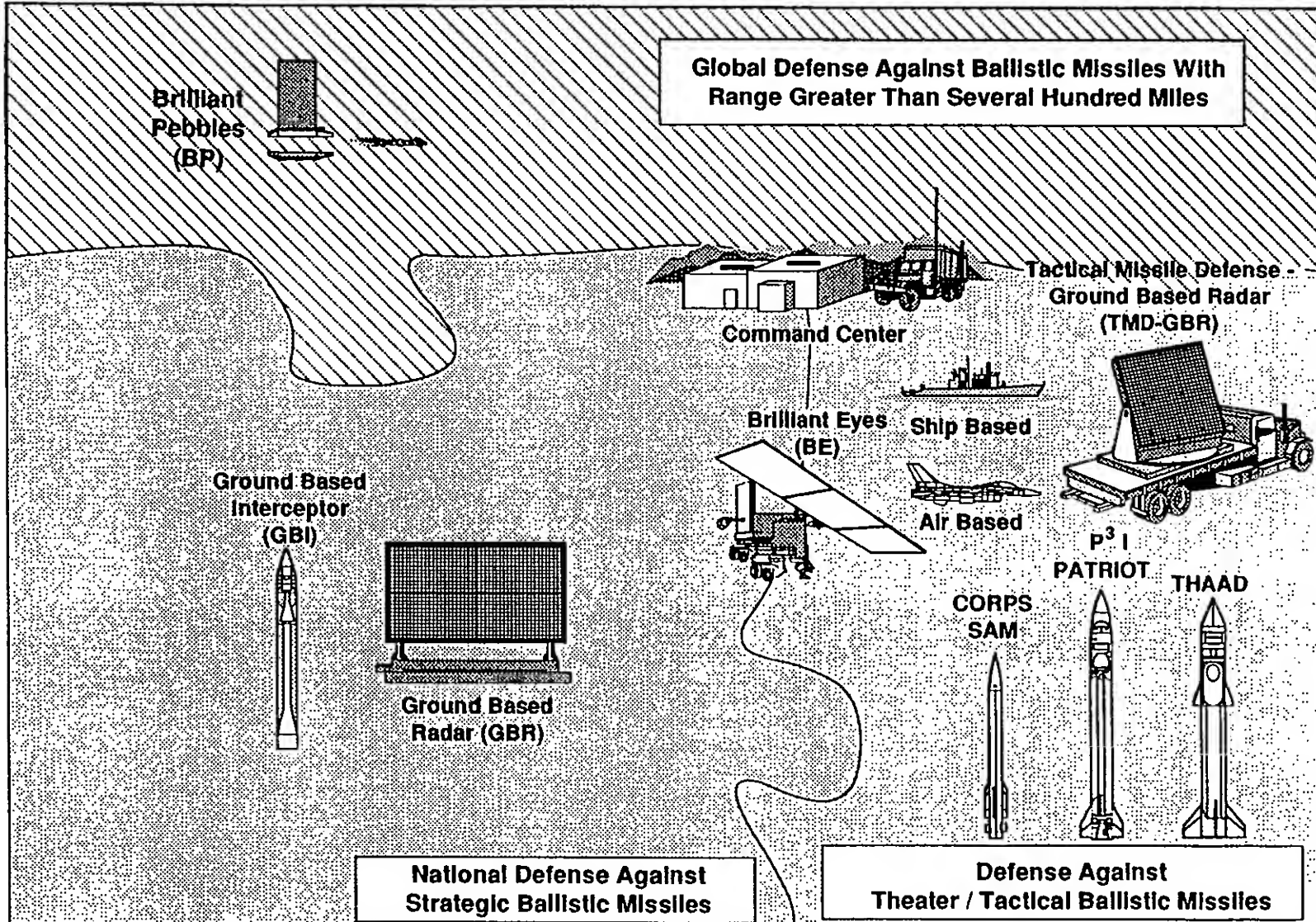
# BRILLIANT PEBBLES

---

- **Space Based Weapon System**
  - **Distributed**
  - **Autonomous**
  - **Reduced Dependence On Other System Elements**
  
- **Continues Revolutionary Design Process**
  - **Exploratory**
  - **Emphasis On Cost And Weight**
  - **Emphasis On Near Term Technology**



# GLOBAL PROTECTION AGAINST LIMITED STRIKES (GPALS)





# PARADIGMS

---

- **Space Weapon**
  - **Militarization Of Space**
  - **Ops Requirement**
  - **Space Debris**
  
- **Autonomous Operation**
  - **Current Satellite Operations**
  - **Impact On Current Systems**
  - **Collision Avoidance**
  
- **Mass Produced Satellite**
  - **Affordability**
  - **Reliability**



# BRILLIANT PEBBLES FUNCTIONALITY

---

**Detect: Detect And Track Booster / PBV / RV**

**Control: Upon Release Authority (From Man-In-The-Loop), Guides Itself To Target**

**Engage: Hit-To-Kill Interceptor**

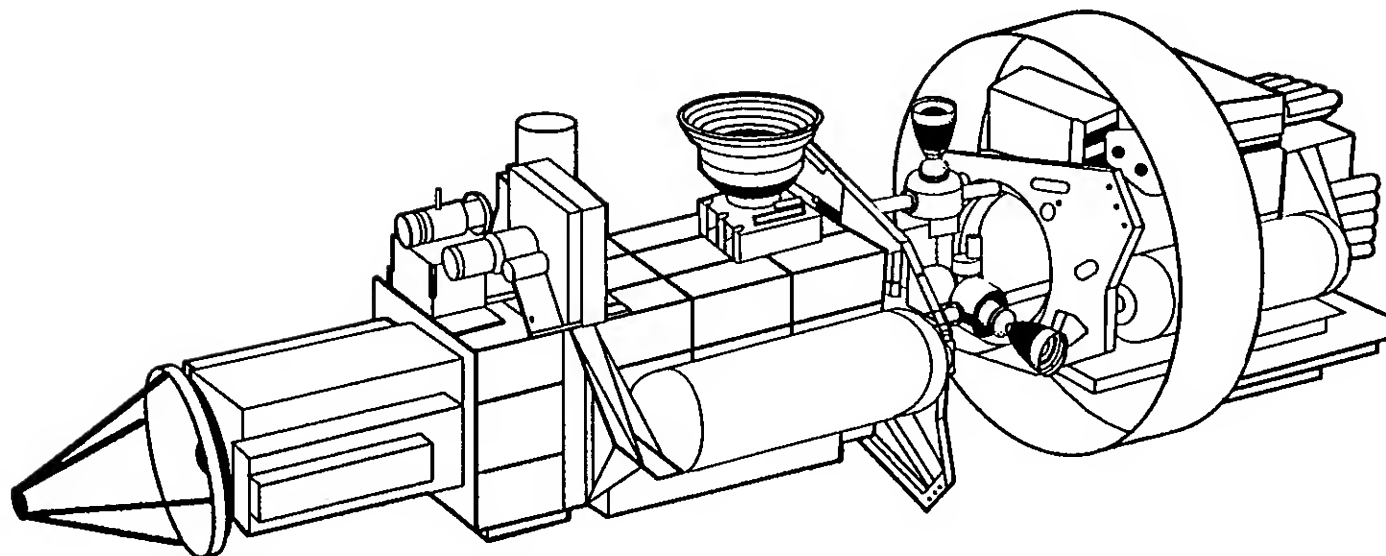
**Support: Built In Support System (Power, Cooling, Navigation, Computing, etc.)**

**Perform Many Functions On a Single  
(But Proliferated) Platform**



# LLNL (AIT) CDV INTERCEPTOR

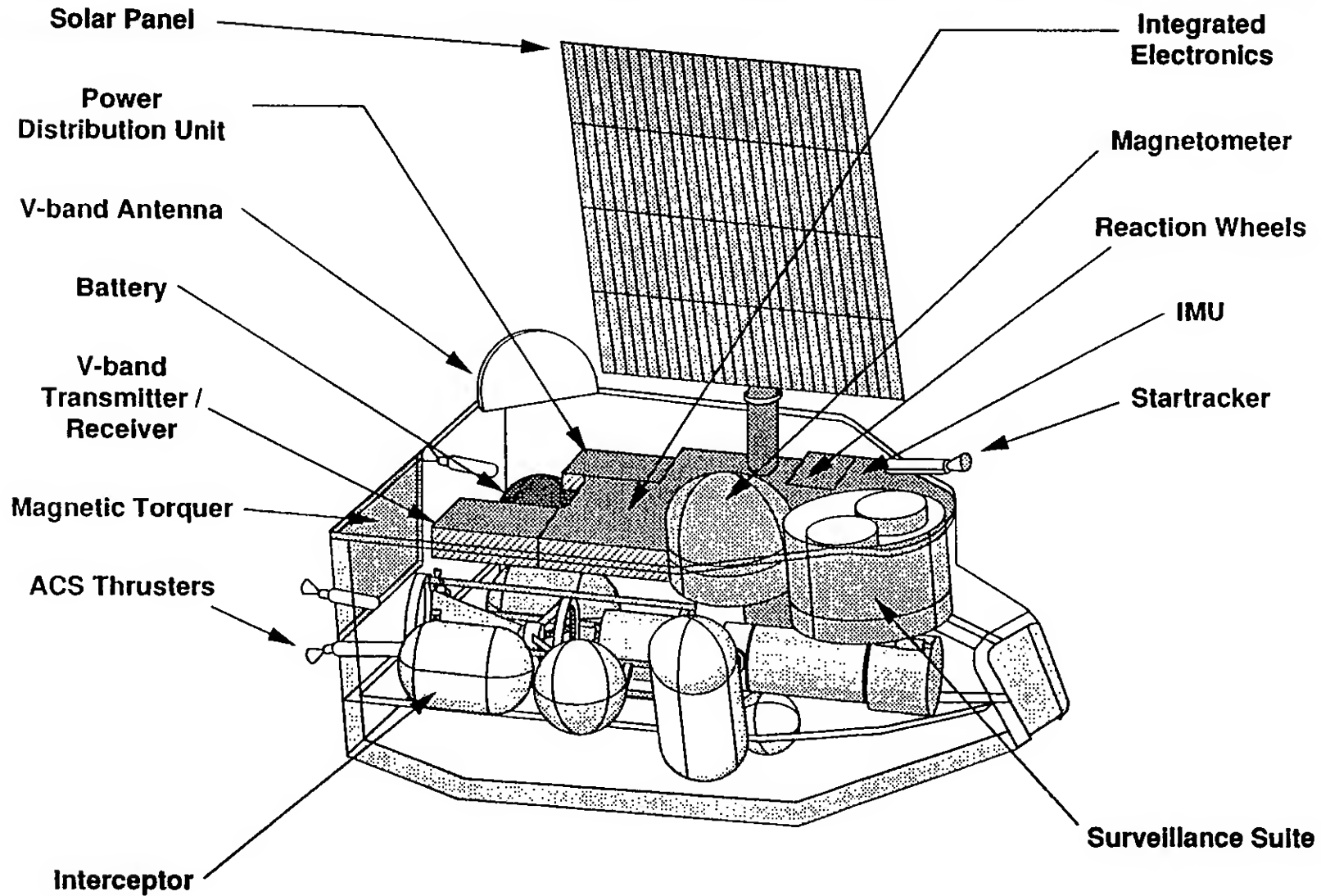
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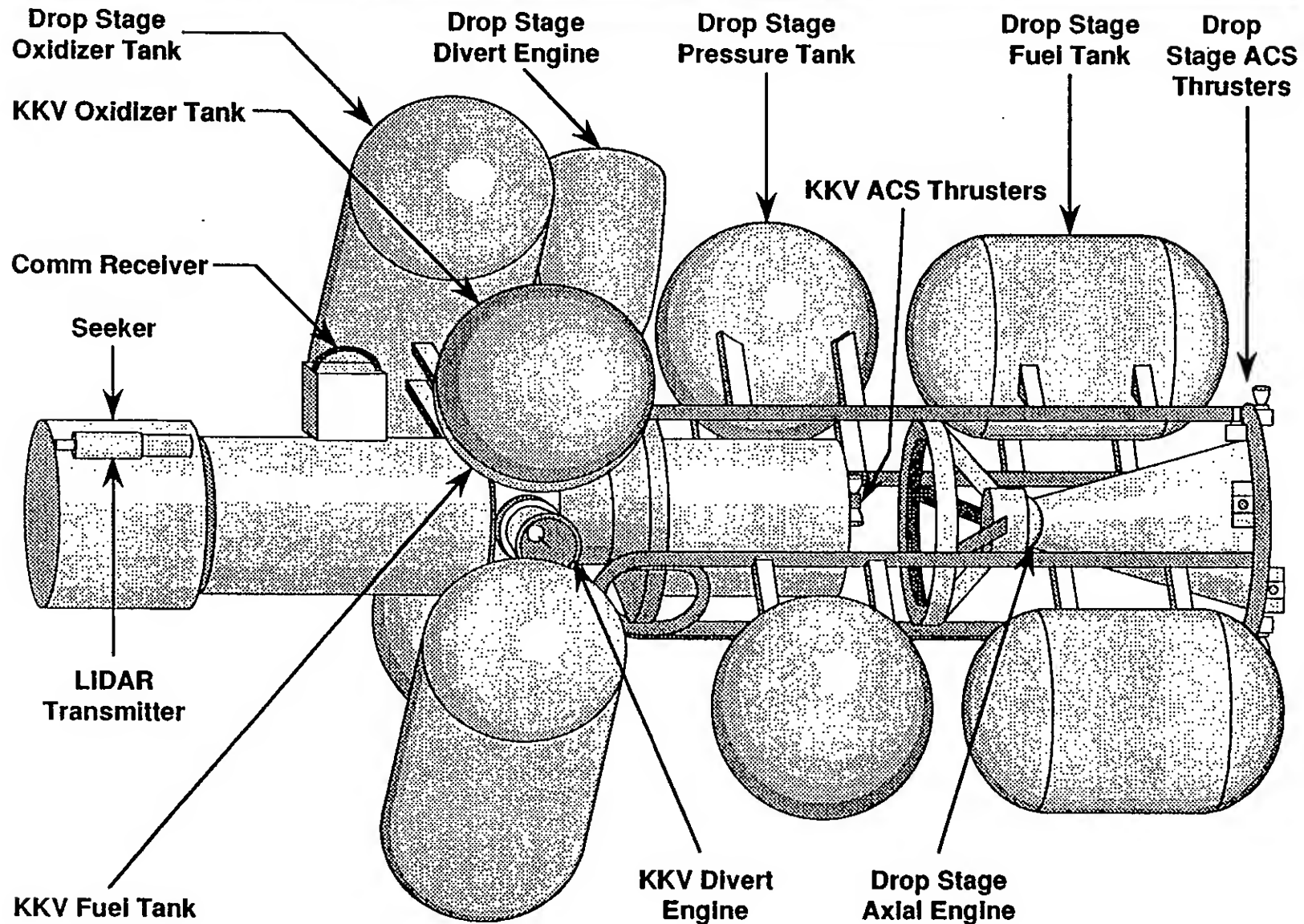


# MARTIN MARIETTA BRILLIANT PEBBLES LIFE JACKET



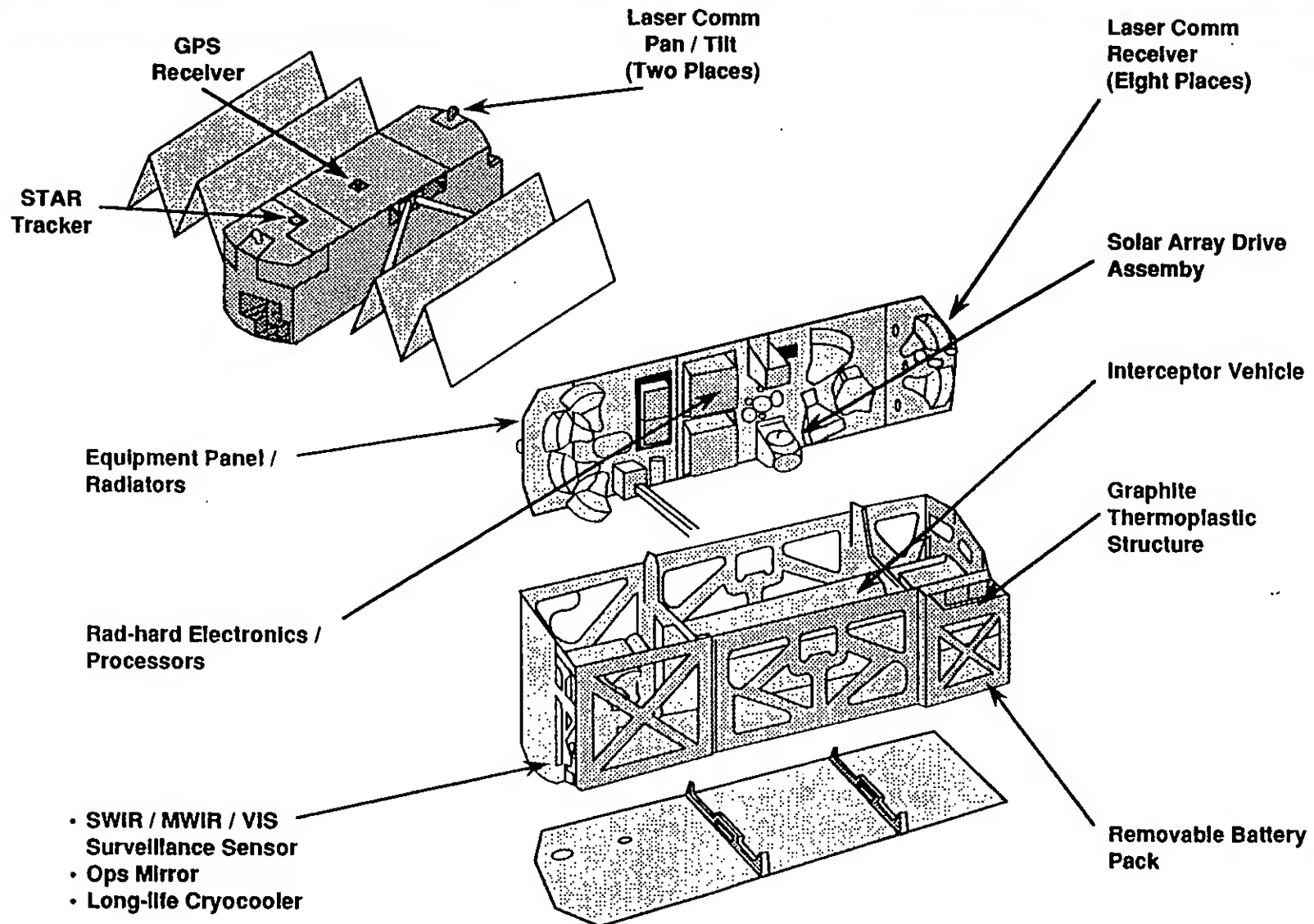


# MARTIN MARIETTA BRILLIANT PEBBLES INTERCEPTOR



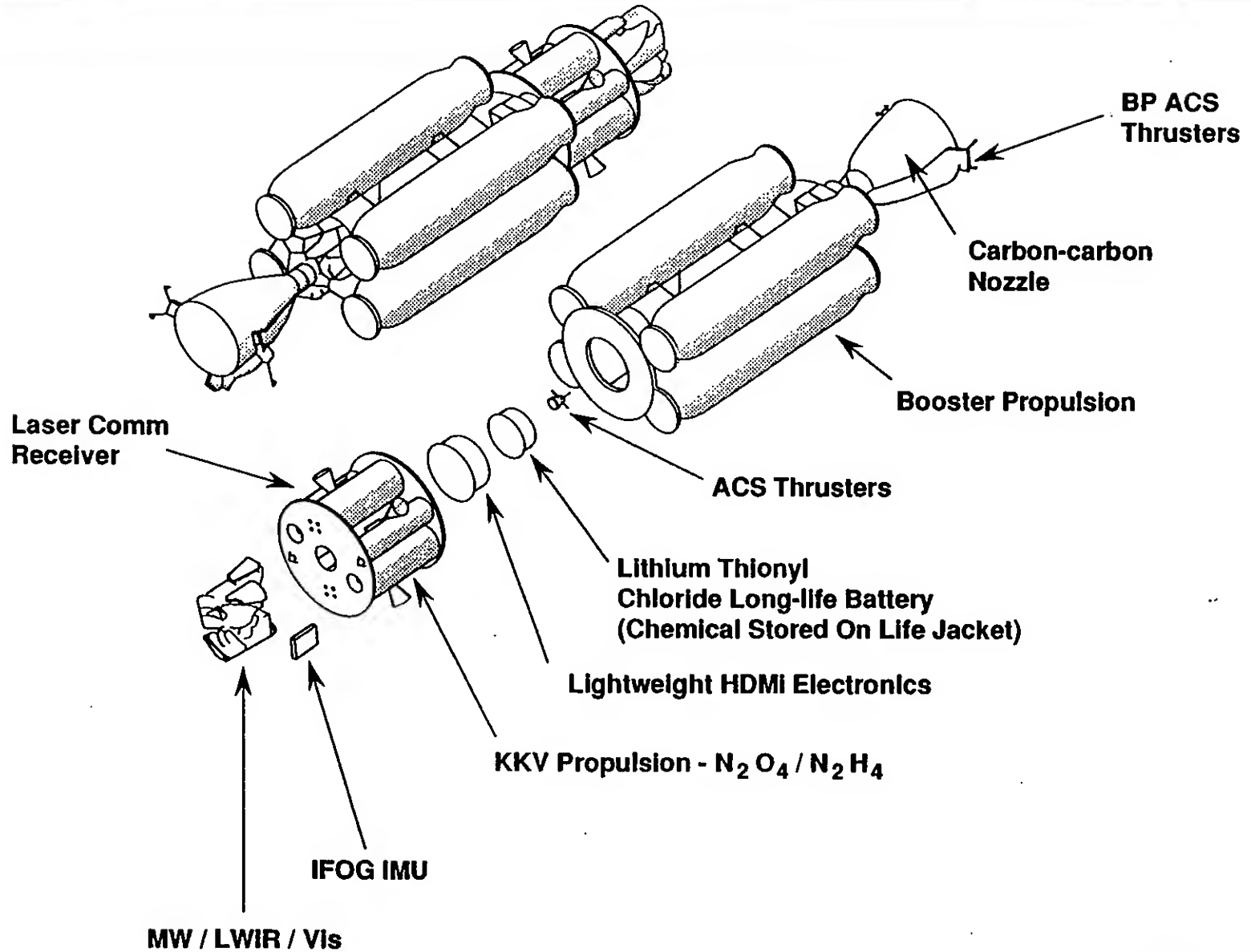


# TRW BRILLIANT PEBBLES LIFE JACKET





# TRW BRILLIANT PEBBLES INTERCEPTOR





# AGENDA

---

- **Space Based Interceptor Evolution**



- **Acquisition Strategy**

- **Test Program**

- **Programmatics**

- **Congressional Issues / Treaty Compliance**

- **Summary**



# ACQUISITION OBJECTIVES

---

- **Streamlined Acquisition**
- **"Fly Before Buy" Through Test Vehicles**
- **Encourage Industrial Innovation**
- **No Specifications Until EMD, Then Carefully Tailored**

**Develop, Demonstrate And Produce  
1 - 10K Brilliant Pebbles**



# ACQUISITION STRATEGY

---

- **Concept Definition**
- **Pre-EMD Program Features**
- **EMD / Production**



# AGENDA

---

- **Space Based Interceptor Evolution**
- **Acquisition Strategy**
-  • **Test Program**
- **Programmatics**
- **Congressional Issues / Treaty Compliance**
- **Summary**





# FLIGHT TEST PROGRAM

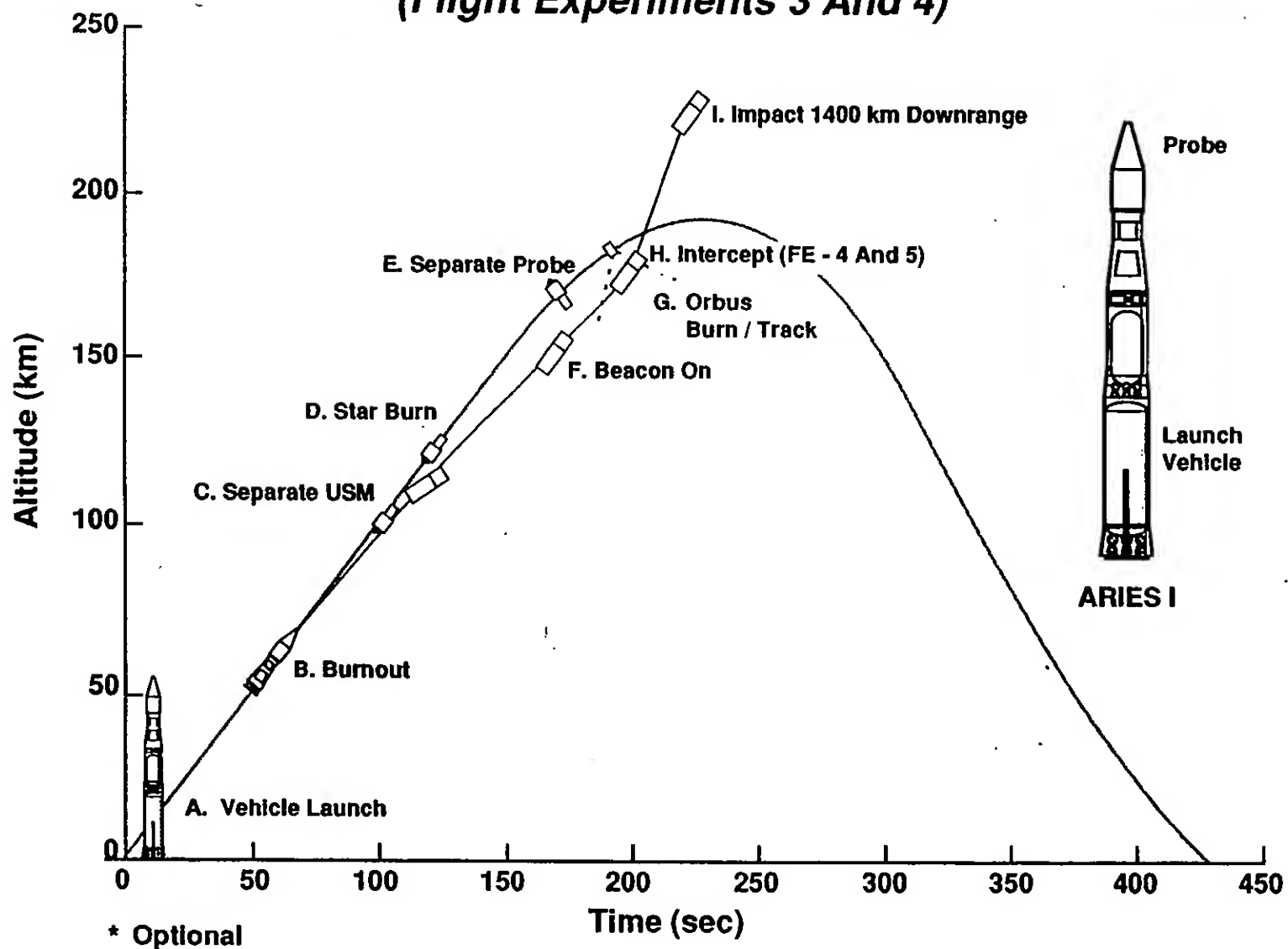
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- **LLNL Leads For Flight Experiments 1-4 (Through 1992)**
  - **Pre-EMD Contractors Become Observers On These Experiments**
- **TRW And Martin Marietta Lead Beginning With BP-1T And BP-1M**
  - **LLNL Advises Industry**
  - **LLNL Continues Critical Technical Development**



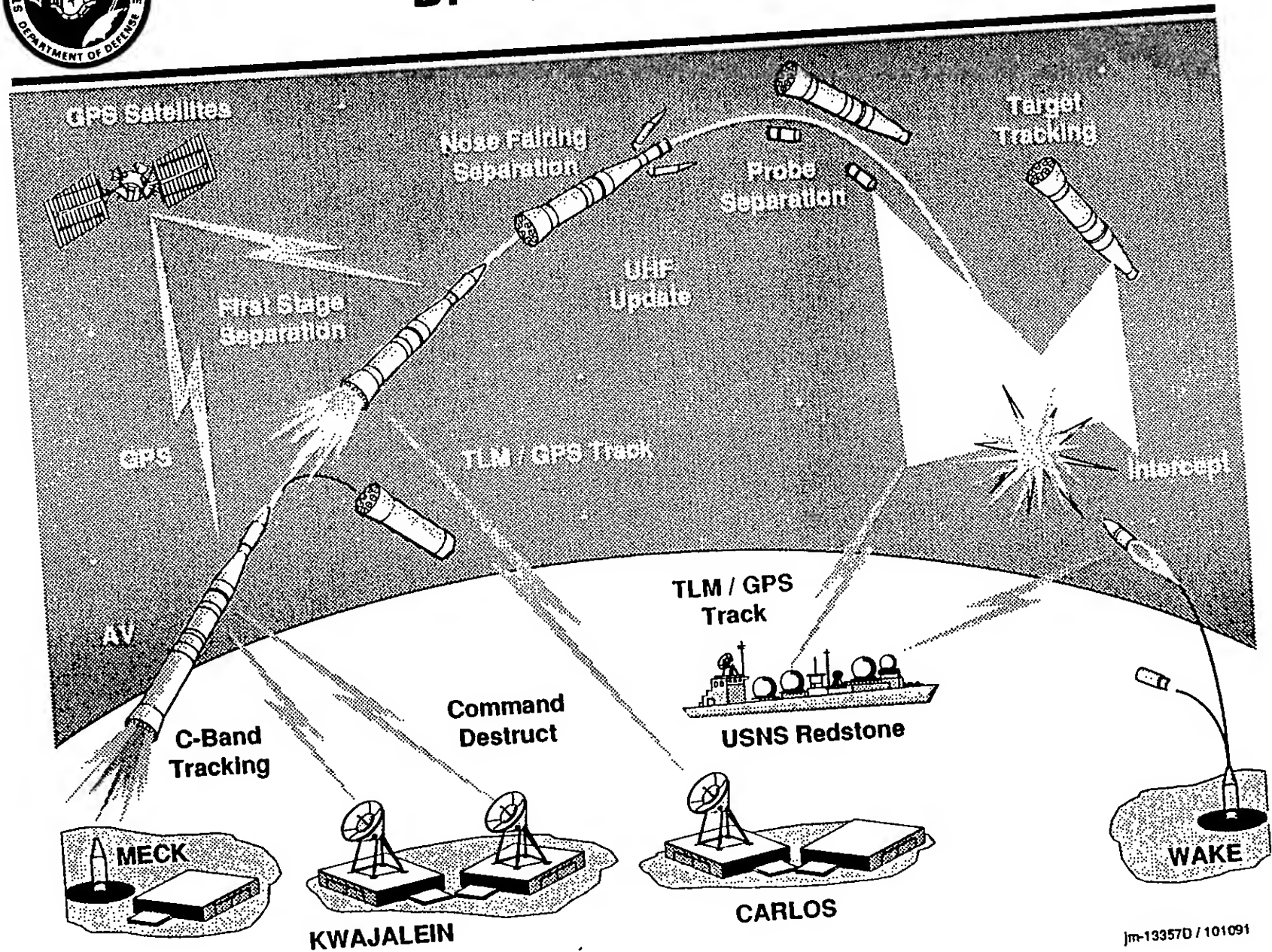
# LLNL PHASE II EXPERIMENT CONFIGURATION

*(Flight Experiments 3 And 4)*





# BP - 1M MISSION





# AGENDA

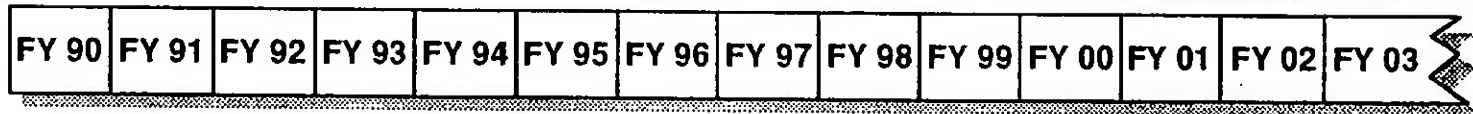
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- **Space Based Interceptor Evolution**
- **Acquisition Strategy**
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- **Summary**





# BP PROGRAM SCHEDULE



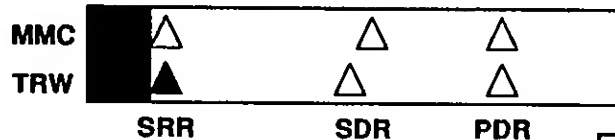
## Program Milestones



### Concept Definition

6 Contractors

### Pre-EMD



### EMD



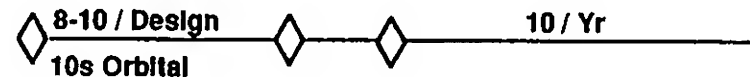
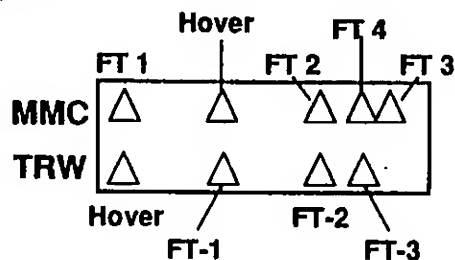
### Production



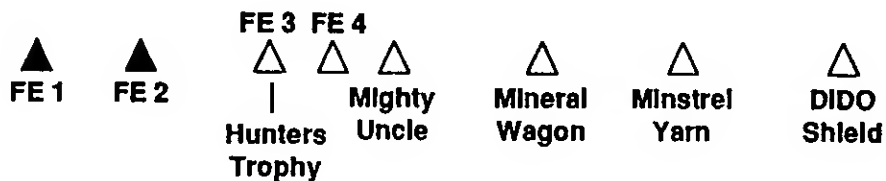
### Contractor Tests



### Flight Test



### LLNL / UGT Experiments





# PROGRAM MILESTONES

---

## **FY 91**

- **LLNL Flight Tests 1, 2**
- **Concept Development Phase Ended, Down Selection For Pre-EMD**
- **Pre-EMD Contracts Initiated**
- **GPALS DAB-GPALS Management Strategy**

## **FY 92**

- **GPALS DAB-GMD Baseline Approval**
- **SRR**
- **LLNL Flight Test 3**

## **FY 93**

- **BP Contractor Pre-EMD Flight Experiment BP-1M**
- **LLNL Flight Test 4**
- **SDR**



# **BP PROGRAM PARTNERS - ROLES AND RESPONSIBILITIES**

---

- **SDIO**
  - **Manage**
  - **Integrate**
  - **Risk Mitigation**
  
- **Services**
  - **Army Support To Test Program**
  - **Air Force Operating Locations And Continuous Technical Support**
  
- **LLNL**
  - **Initial Concept**
  - **Functional Concept Feasibility (Flight Experiments)**
  - **Selected Component Technology Innovations**
  - **Technical Advisor**
  
- **Industry**
  - **Complete Detailed Design**
  - **Ground And Flight Testing Of Detailed Design**
  - **Producibility / Manufacturing Technology**
  - **Balance Performance, Producibility, Operability, Supportability, Affordability And Schedule**



# PRE-EMD CONTRACTORS

Contractors	City	State
Martin Marletta - Prime	Denver	CO
IBM	Manassas	VA
Mission Research Corporation	Colorado Springs	CO
Aerojet Propulsion Division	Sacramento	CA
Litton	Woodland Hills	CA
Stanford Telecommunications	Reston	VA
OCA	Garden Grove	CA
LIRIS	Lexington	MA
MDESC	St. Louis	MO
Eagle Picher	Joplin	MO
Babcock	Orange	CA
Courtaids	Bennington	VT
AOI	Rolling Hills Estate	CA
OEA	Aurora	CA
Hi-Shear	Torrance	CA
Wittaker	Hollister	CA

Contractors	City	State
TRW - Prime	Redondo Beach	CA
Hughes Aircraft	El Segundo	CA
Defense System, Inc	Vienna	VA
Photon Research Association	San Diego	CA
Mission Research Corporation	Santa Barbara	CA
SPARTA	Laguna Hills	CA
Prairie View A&M	Prairie View	TX
Alliance Infonet	Costa Mesa	CA
Applied Technology Association	Mountain View	CA
Sun Computers	Carson	CA
Frontier Electronics	Stillwater	OK
Romallo Tool & Die	Torrance	CA
Sloane Company	Sun Valley	CA
Spaceonics Industrial, Inc	Harbor City	CA
Webber Cable & Electronics	Cerritos	CA
Bob Lewis Machine	Gardena	CA
Omega Engineering, Inc	Stanford	CT
C.W. Swift & Associates	Van Nuys	CA
LSI Logic	Milpitas	CA
Ward / Davis	Redondo Beach	CA
Lambda Novatronics, Inc	Del Rey Beach	FL
Qualcom	San Diego	CA
London Engineering	Gardena	CA
Precision Bearing Center	West Lebanon	NH





# RISK MITIGATION POSSIBILITIES

---

- **We Are Looking For Technologies To Support Our Risk Mitigation Program That Are**
  - **Extremely Lightweight**
  - **Robust**
  - **Survivable In A Space Environment With High Reliability**
  - **Requires Low Input Power**
  - **Readily Available**
  
- **Specific Areas Of Interest**
  - **High Resolution Long Wave Infrared (LWIR)**
  - **60 GHz Communications**
  - **Laser Communications**
  - **Cryocooler**
  - **Laser Imaging, Detection, And Ranging (LIDAR)**
  - **Solar Power**
  - **Long Life Batteries**
  - **Inertial Measurement Unit**



# RISK MANAGEMENT POINTS OF CONTACT

---

**Martin Marietta Strategic Defense Systems**  
**Attn: Ms. Kathy Tobey Ms: F4066**  
**P.O. Box 179**  
**Denver, CO 80201**  
**Telephone Number (303) 971-3598**

**TRW Military Space System Divisions**  
**Attn: Mr. Norm Hollinger**  
**One Space Park**  
**Redondo Beach, CA 90278**  
**Telephone Number (213) 814-9169**

**Lawrence Livermore National Laboratory**  
**Attn: Mr. Nick Collella**  
**P.O. Box 808**  
**Livermore, CA 94550**  
**Telephone Number (510) 423-8452**

**Department Of Defense**  
**Strategic Defense Initiative Organization**  
**Attn: CPT W. Russell Hall**  
**The Pentagon**  
**Washington, D.C. 20301-7100**  
**Telephone Number (703) 693-1612**



# AGENDA

---

- **Space Based Interceptor Evolution**
- **Acquisition Strategy**
- **Test Program**
- **Programmatics**
- ➔ • **Congressional Issues / Treaty Compliance**
- **Summary**



## 1992 CONGRESSIONAL ISSUES

---

- **Keeping Brilliant Pebbles In Research And Development Phase**
- **ABM Treaty Compliance For BP Testing**
- **Cooperative Funding From Allies**

**We Are Fully Compliant With The 1991  
Missile Defense Act And ABM Treaty.  
We Are Exploring Allied Participation**



# AGENDA

---

- Space Based Interceptor Evolution
- Acquisition Strategy
- Test Program
- Programmatic
- Congressional Issues / Treaty Compliance
- ➔ • Summary



# SUMMARY

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## *World Of Opportunity - Areas To Solicit*

- **MMC, TRW**
  - **Provide Positive Contributions In The Areas Of Cost And Weight Reduction, Effectiveness And Producibility**
  
- **Government**
  - **Provide Risk Mitigation And Enabling Technology**
  
- **TASC, BDM**
  - **Provide Program Management Support In Areas Of Systems Integration, Resource Management And Test And Evaluation**

# STRATEGIC DEFENSE INITIATIVE

## Advance Planning Briefing For Industry



2 MAR 92

**COL Carl E. Drewes, USA**  
**Director, National Missile Defense Segment**  
**Strategic Defense Initiative Organization**



# TOPICS

---

- **1991 Missile Defense Act  
(Limited Defense System)**
- **National Missile Defense (NMD) Architecture**
- **Planned Growth Path**
- **Program Strategy**
- **Schedules**
- **Critical Factors For Deployment**
- **Summary**





# MISSILE DEFENSE ACT OF 1991

---

## *Missile Defense Goal Of The United States*

- **It Is The Goal Of The United States To**
  - **Deploy An Antiballistic Missile System, Including One Or An Adequate Additional Number Of Antiballistic Missile Sites And Space Based Sensors, That Is Capable Of Providing A Highly Effective Defense Of The United States Against Limited Attacks Of Ballistic Missiles**
  - **Maintain Strategic Stability**
  - **Provide Highly Effective Theater Missile Defenses (TMDs) To Forward Deployed And Expeditionary Elements Of The Armed Forces Of The United States And To Friends And Allies Of The United States**



# 1991 MISSILE DEFENSE ACT LIMITED DEFENSE SYSTEM

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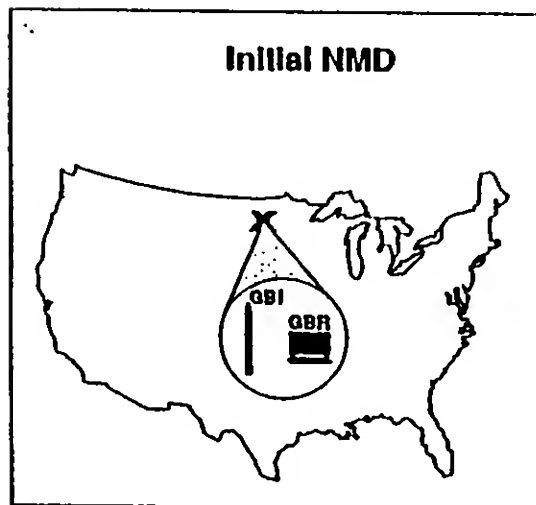
- Design To *Protect* The United States Against *Limited* Ballistic Missile Threats
  - *Accidental Or Unauthorized Launches*
  - *Third World Attacks*
- Develop For *Deployment* a
  - *Cost Effective*
  - *Operationally Effective*
  - *ABM Treaty Compliant*
- Antiballistic Missile System At A *Single Site* As The *Initial Step* Toward *Deployment* Of A Highly Effective Antiballistic Missile System
- By The Earliest Date Allowed By The Availability Of Appropriate Technology Or By FY 96



# NATIONAL MISSILE DEFENSE ARCHITECTURE

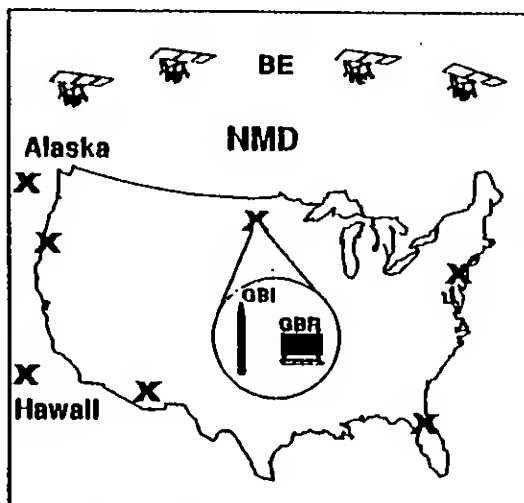
**Goal: Highly Effective Defense Of The U.S. Against Limited Attacks Of Ballistic Missiles — Consistent With Strategic Stability**

**Initial Site Defense System  
(FY 96 - 97)**



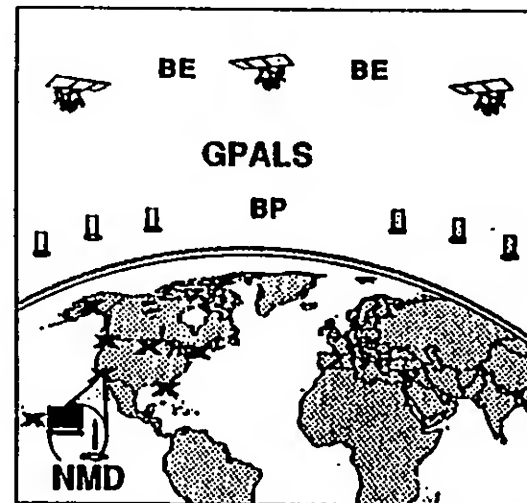
(GBI) Ground Based Interceptor  
(GBR) Ground Based Radar

**Limited Defense System  
(FY 98 - 02)**



(BE) Brilliant Eyes  
(X) Missile Defense Site

**With Space Based Interceptors  
(FY 00 - 03)**



(NMD) National Missile Defense  
(BP) Brilliant Pebbles

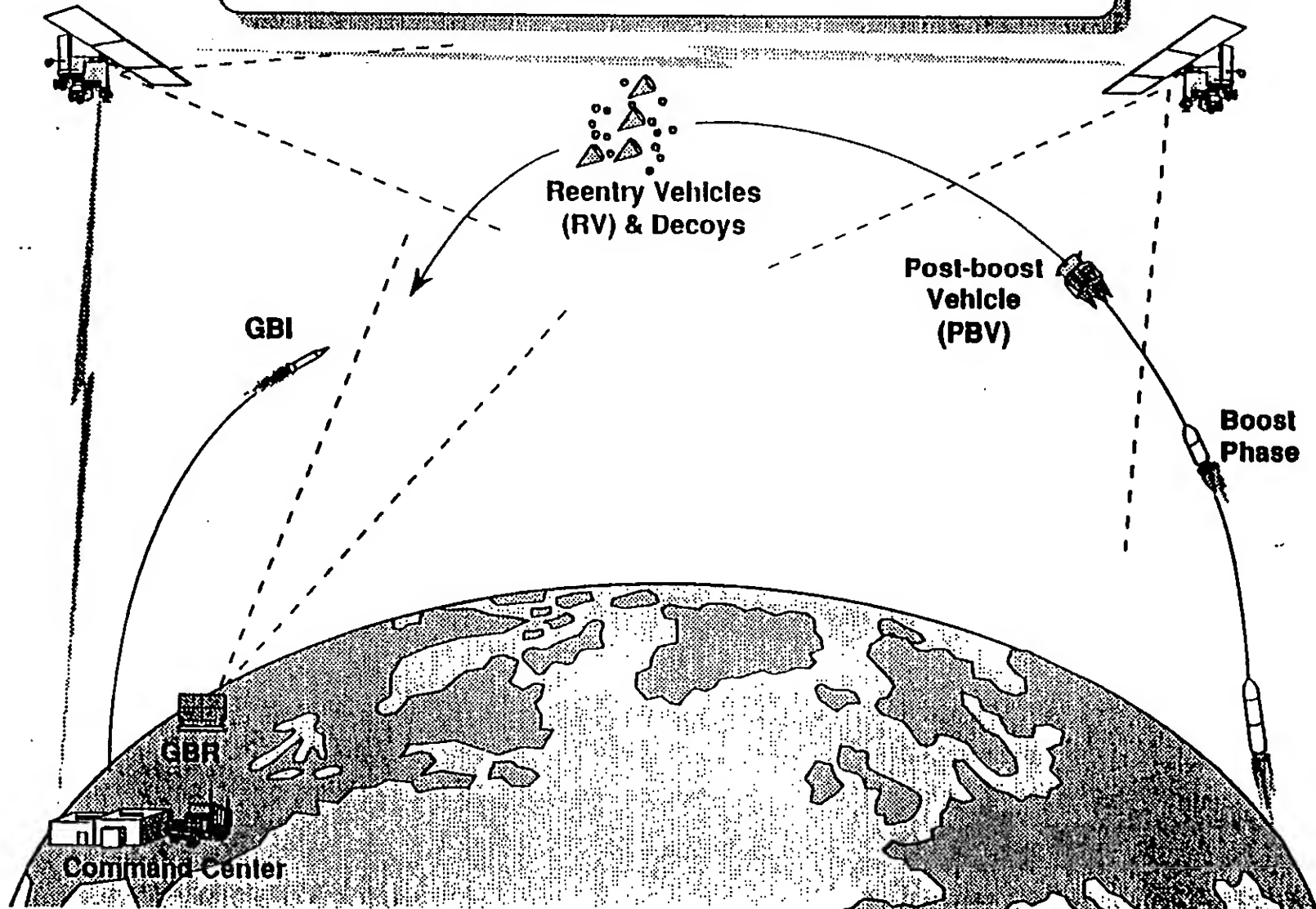


# NMD ARCHITECTURE

Brilliant Eyes

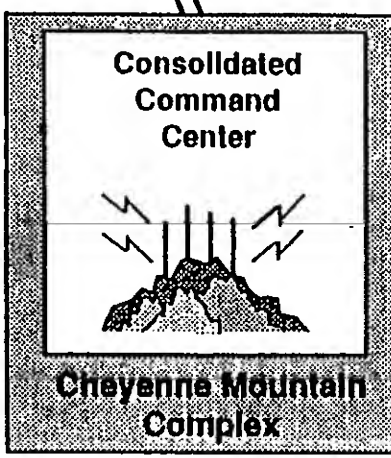
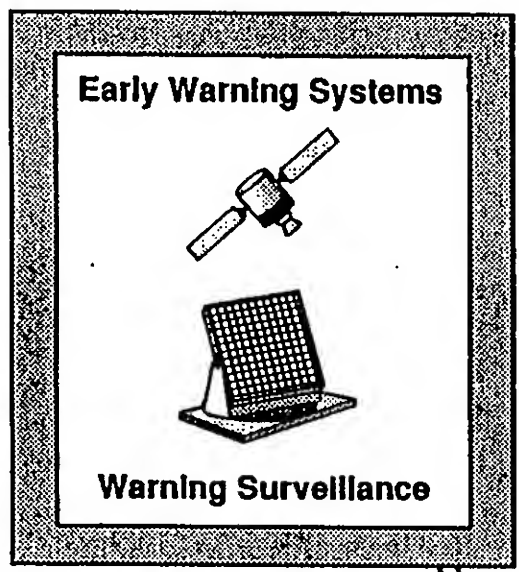
Defense Against Strategic Ballistic Missiles

Brilliant Eyes

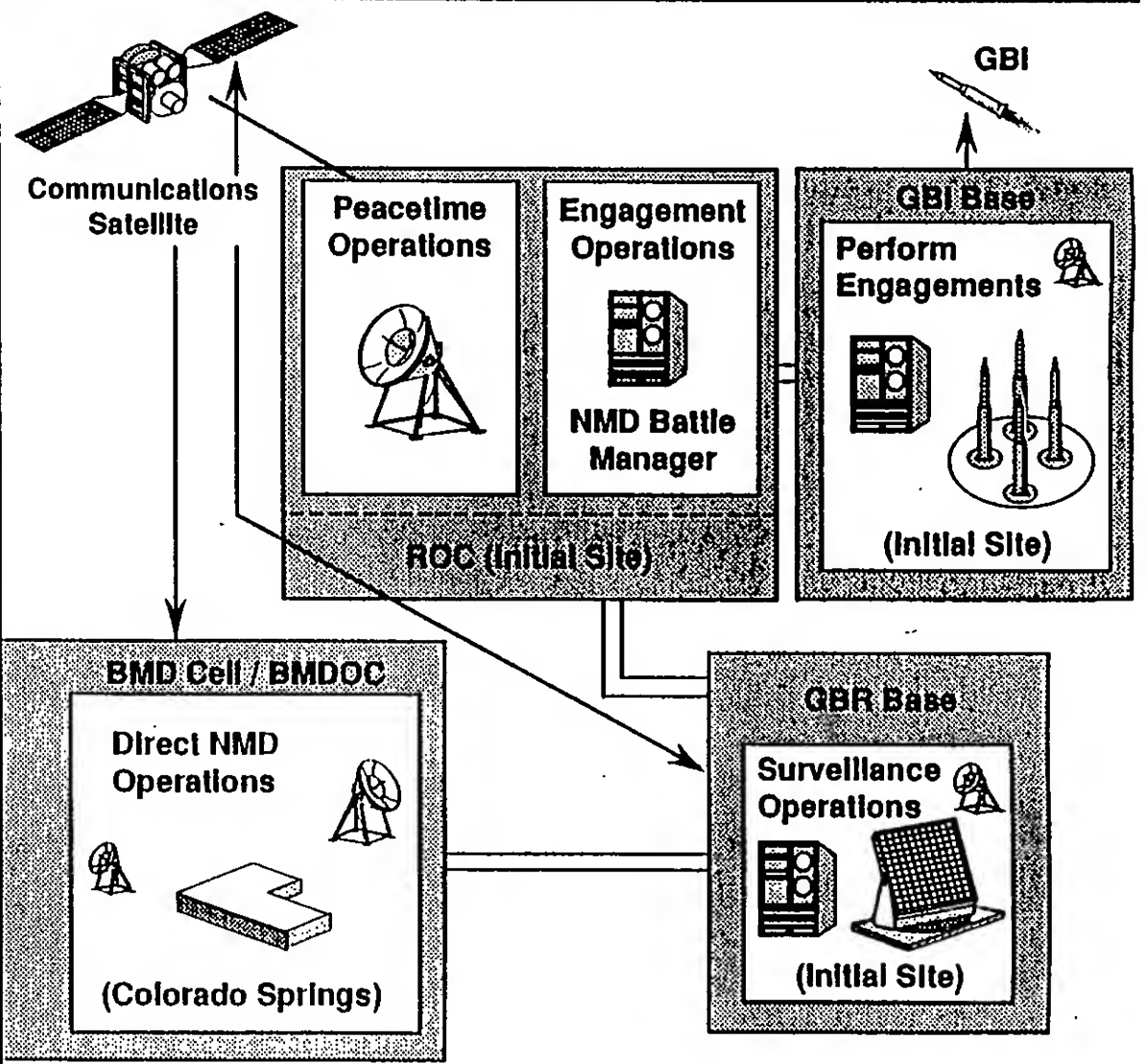




### Current Warning Architecture

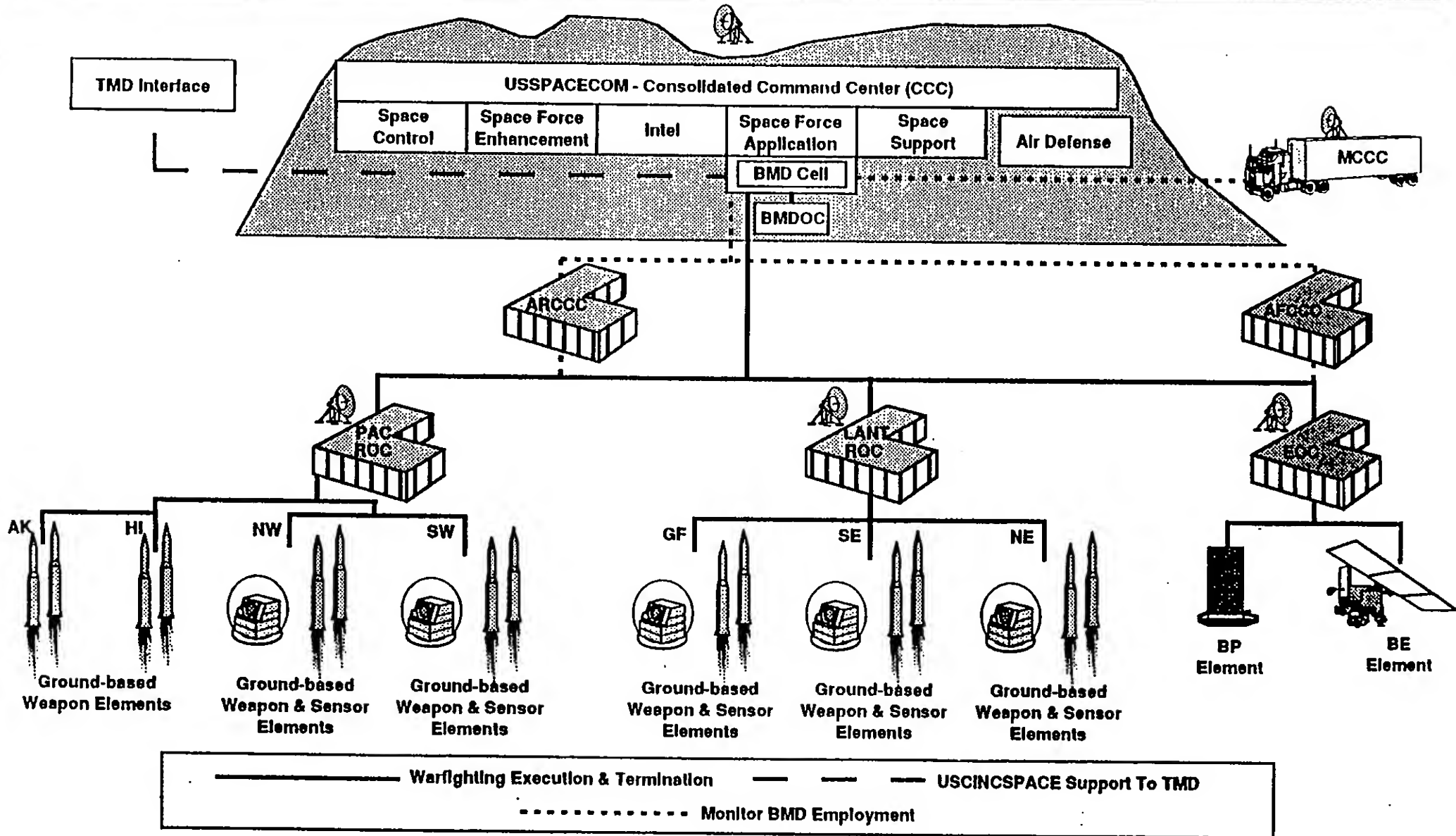


### Initial NMD Segment Architecture



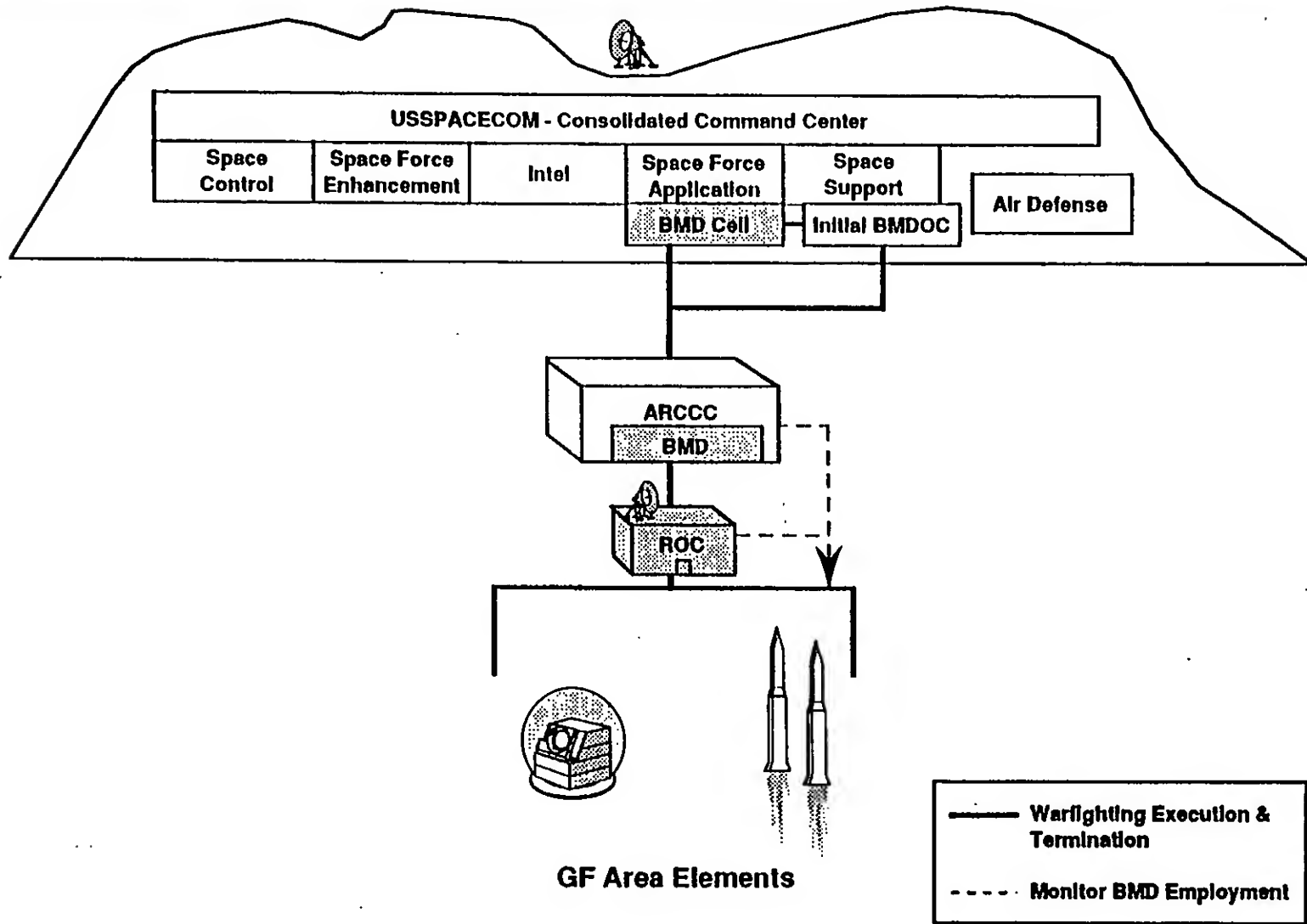


# NMD COMMAND AND CONTROL STRUCTURE





# INITIAL NMD COMMAND AND CONTROL STRUCTURE





# WHY INITIAL NMD DEPLOYMENT ?

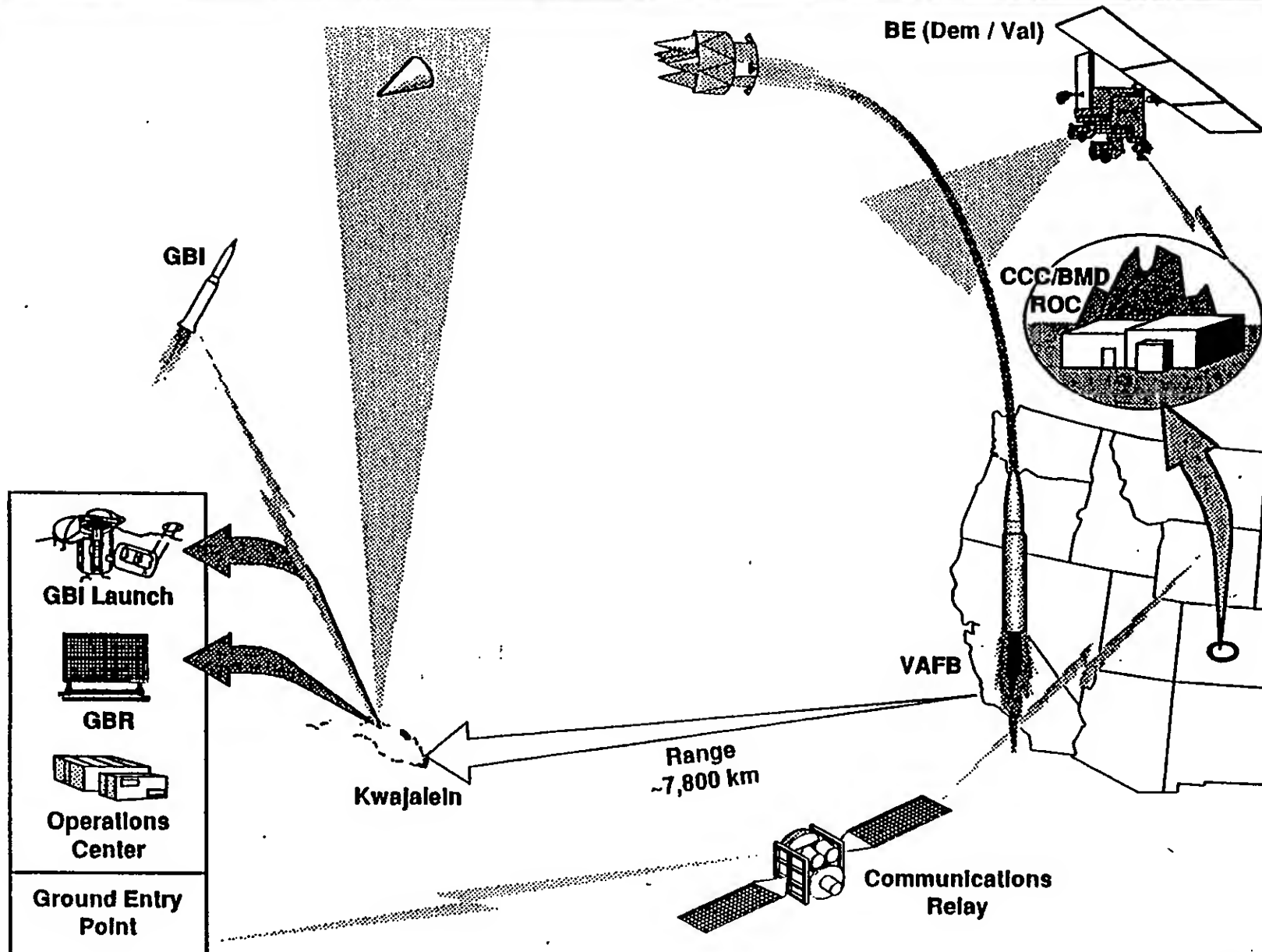
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- **Responds To The 1991 Missile Defense Act**
- **Protects Most Of U.S.A. Against Certain Limited, Accidental, And Unauthorized Ballistic Missile Strikes**
- **Provides USSPACECOM An Operational And A Training Capability**
- **Provides Evolutionary First Step Toward The Objective GPALS Deployment**
- **Provides And Maintains Strategic Stability**





# INITIAL NMD TEST SCENARIO





# PLANNED NMD GROWTH PATH TO GPALS

---

- **Open Architecture For GPALS**
- **Pre-planned Product Improvements**
- **Interceptor Block Upgrades**
  - **Advanced Discrimination Capability**
  - **Endoatmospheric Capability**
- **Brilliant Eyes**
- **Brilliant Pebbles**
- **GPALS Integration (TMD + NMD + GMD)**



# NMD PROGRAM STRATEGY

---

- **Core Strategy**

- **Deploy Initial Site And Build On It**
- **Continue On Full Deployment Path**
- **Maintain Options To Respond To Uncertain Future With A Robust Technology Base Program**
- **Maintain Consistency With Evolving National And International Policies And Constraints**



# PROBLEM ANALYSIS

---

## *Acquisition Strategy For Initial GPALS / NMD Deployment*

### *Issue*

- How Should Acquisition Milestones And Phases Be Structured For The GPALS Elements That Will Be Deployed In FY 97 To Meet The 1991 Missile Defense Act Mandate?

### *Impacts*

- Execution Of Defense Acquisition Management Policies And Procedures (DoDI 5000.2)s
- Provisions And Requirements In GBI, GBR, And C<sup>2</sup>E Procurement Packages
- FY 94 - 99 POM / Color Of Money

### *Solution*

- Focus System Designs On Suitability, Testability, Producibility, And Supportability For Initial Deployment, And Adaptability For Incremental Growth To Meet Objective GPALS And Uncertain Future
- Insist The Most Mature Technology Be Used To Meet GPALS Effectivity #1 (LOC) Requirements
- Conduct Enhancing Technology Developments / Demonstrations In Parallel With System Development For Infusion As Block Changes
- Fund Advanced Development And Initial Deployment Units With 6.3 Dollars. Fund Fixes, Follow-on Testing, And Upgrades Necessary For Initial Deployment Units To Meet GPALS Effectivity #1 With 6.3 Dollars. Fund System Development And Fix Level III Engineering Documentation For GPALS Effectivities #2 Thru N With 6.4 Dollars. Fund Follow-on Deployment (LRIP / Production) With Procurement Dollars

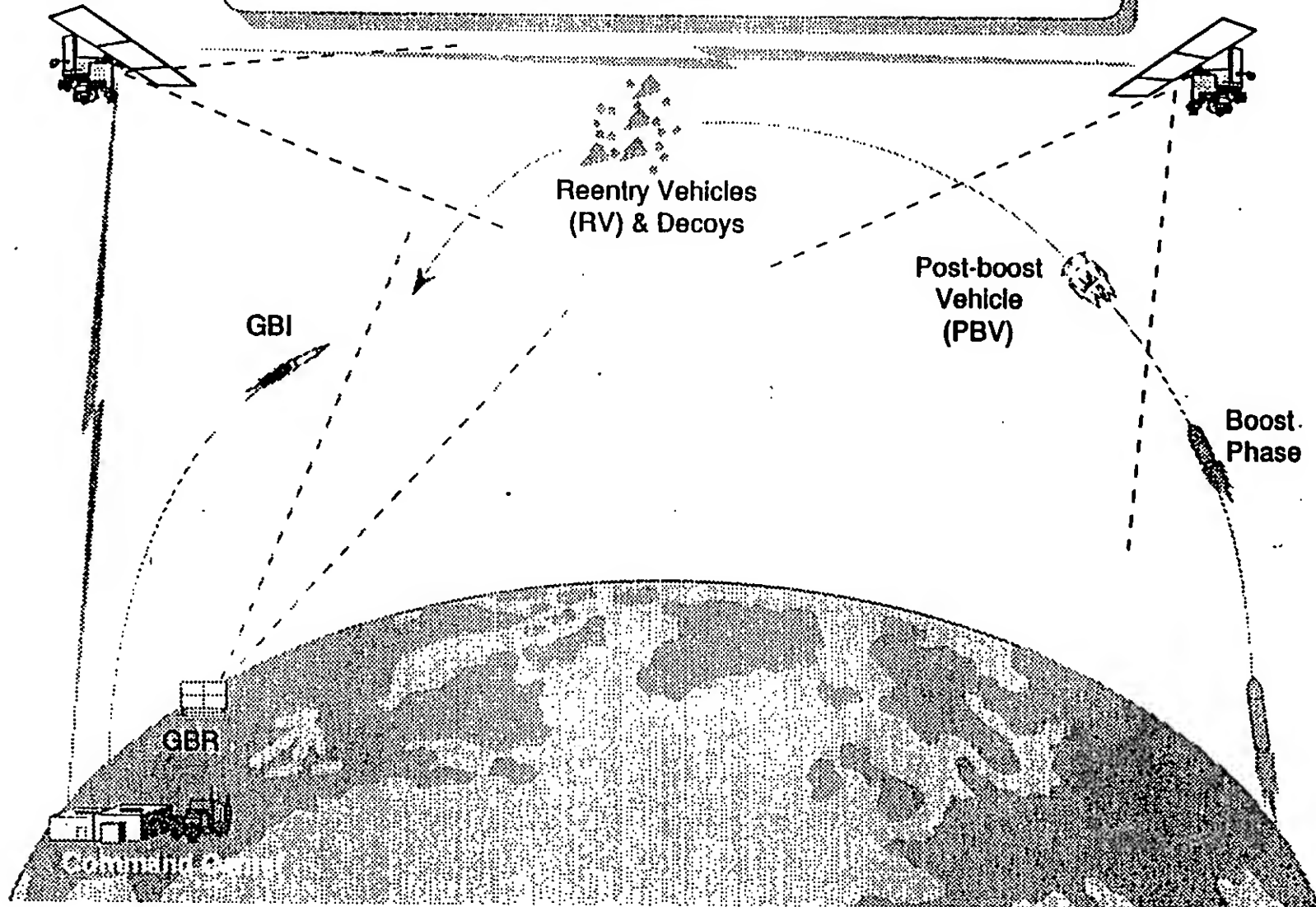


# NMD ARCHITECTURE

Brilliant Eyes

Defense Against Strategic Ballistic Missiles

Brilliant Eyes

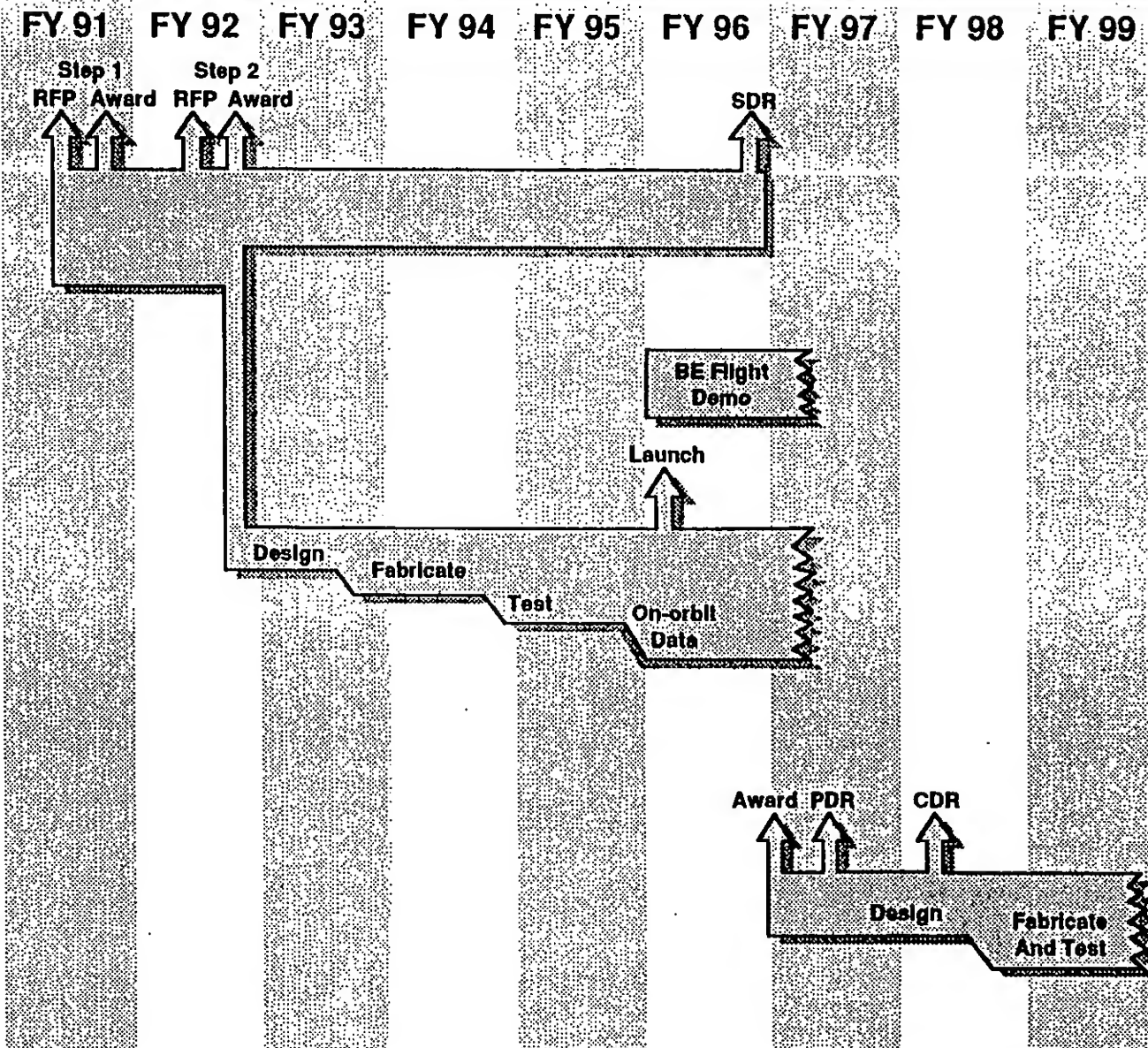




# BRILLIANT EYES PROGRAM SCHEDULE

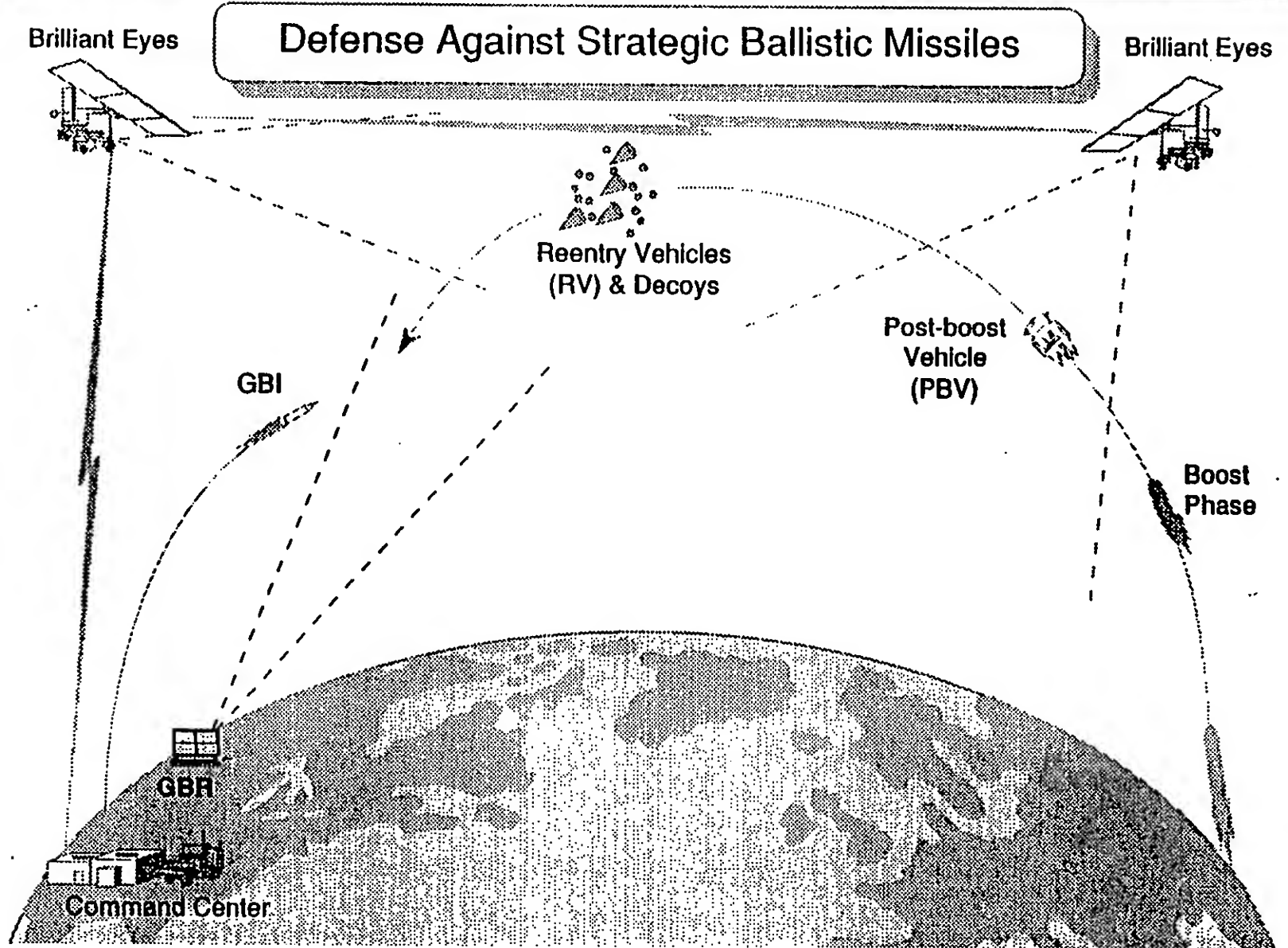
BE Dem / Val

BE EMD





# NMD ARCHITECTURE





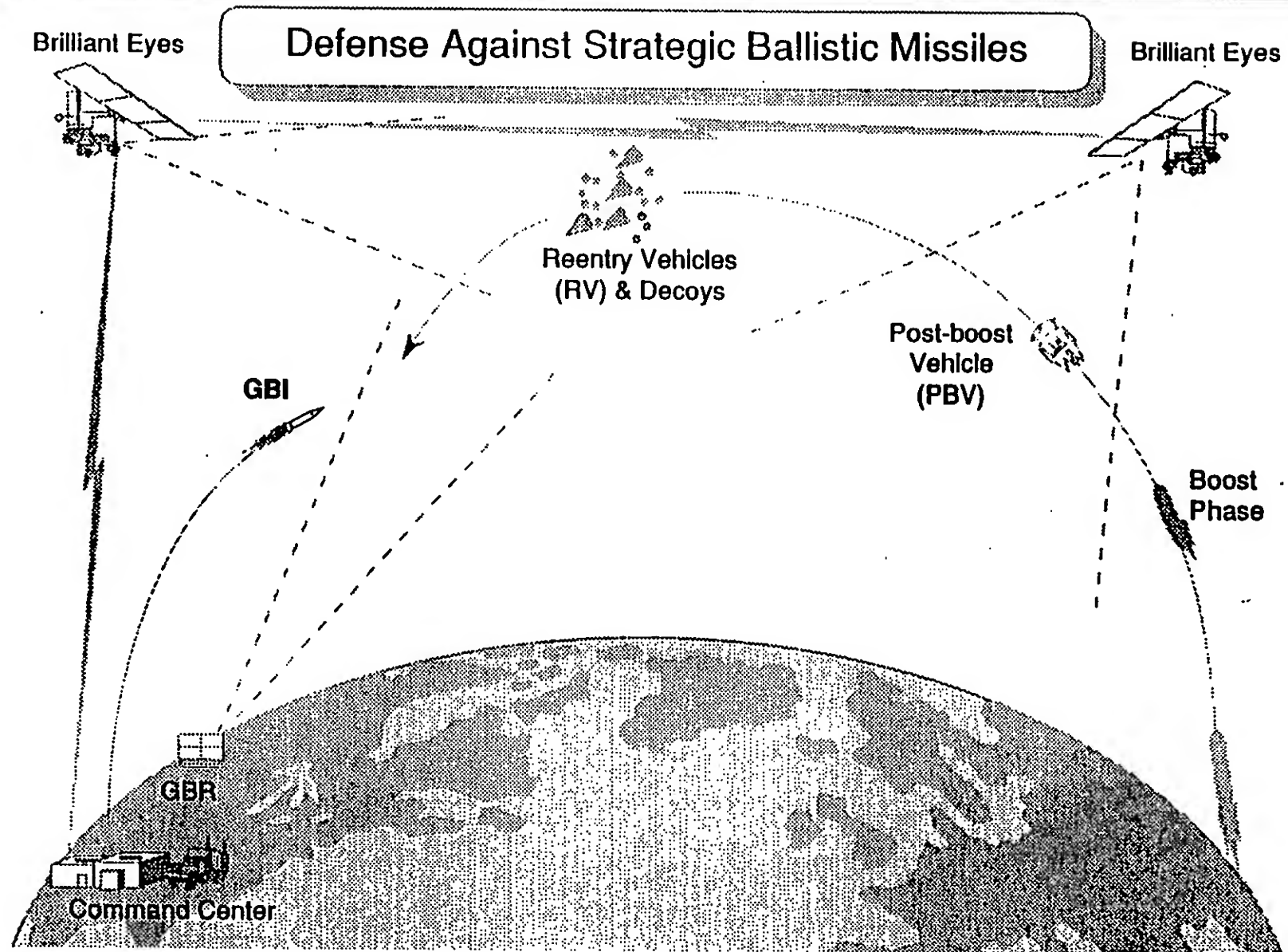
# NMD-GBR SCHEDULE

Fiscal Year	92	93	94	95	96	97	98	99	00	01	02	03
USAKA Dem / Val Radar (GBR-T)	Requirements / Design		CDR	Arrive USAKA	MS II / LRIP	USAKA Ready	FTV Comp Extended Ops	MS III				
						I & T						
Site 1 Dem / Val Radar	Requirements / Design		Sys CDR	Arrive Site 1		EOC		Extended Operations				
Site 2 Prod Radar												
Site 3 Prod Radar												
Site 4 Prod Radar												
Site 5 Prod Radar												



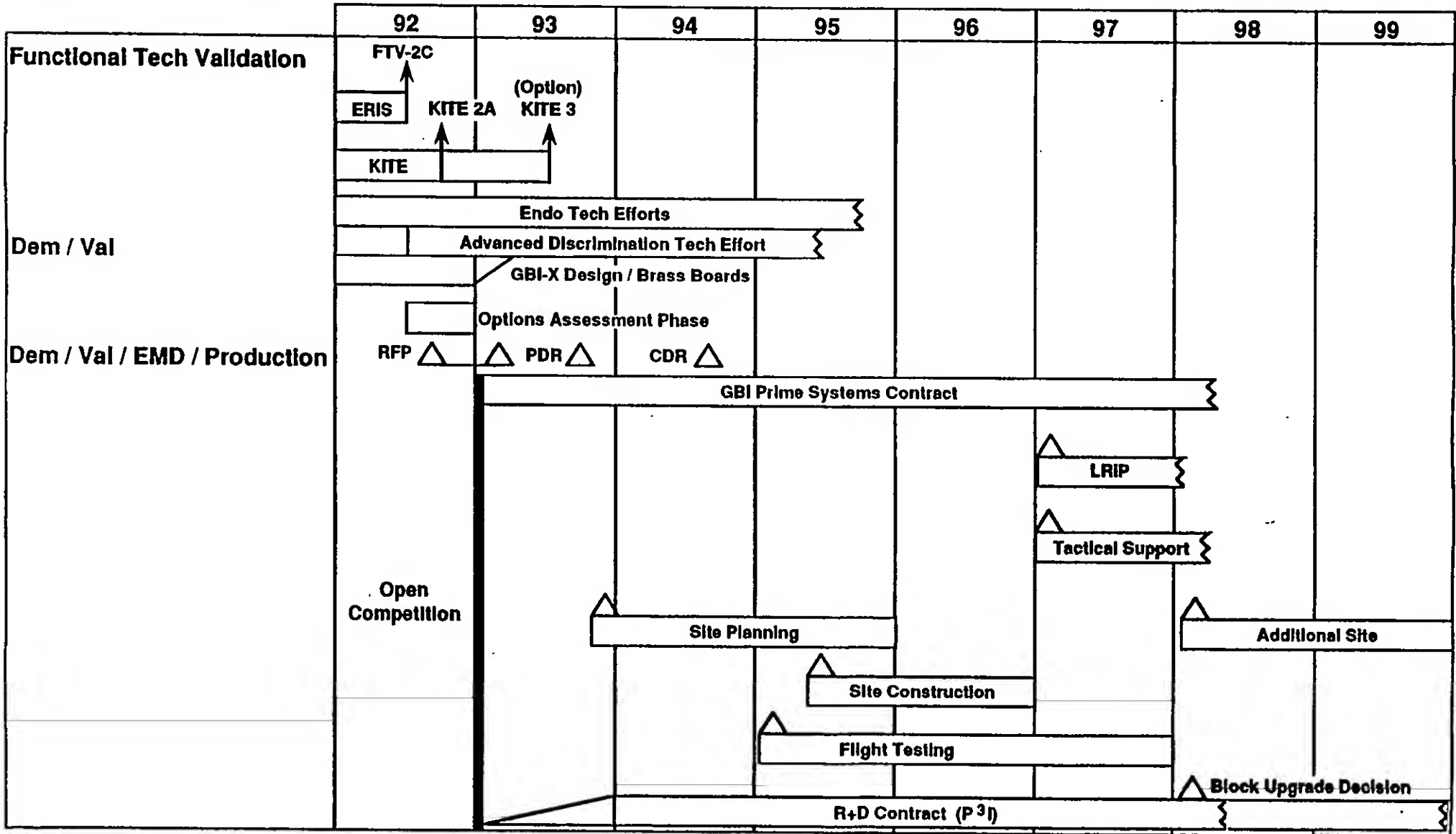


# NMD ARCHITECTURE





# GROUND BASED INTERCEPTOR PROGRAM SCHEDULE





# OPTIONS ASSESSMENT FOR GBI

---

- **GBI Must Meet NMD Segment Effectivity Performance Requirements**
- **Deployable Exo Interceptor At GF, Upgradable To Full Operational Capability Later**
- **GBI / NMD Options**
  - **Options For Exo GBI In FY 97**
    - **Development**
    - **Fabrication**
    - **Test**
    - **Integration**
    - **Production**
    - **Deployment**
  - **Options That Improve NMD Requirements Documents**
    - **Industry Perspective On Critical Requirements**
    - **Allocations Between GBI And NMD Segment**
  - **Options For GBI Performance Enhancement**
    - **Risk Reduction**
    - **Approach For Technology Infusion To Meet Full Operational Capability**



# GBI OPTIONS ASSESSMENT

Activity	FY 92								FY 93			
	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
Release CBD Notice	▲ <sup>19</sup>											
Release Options RFP		▲ <sup>6</sup>										
Industry Proposal Prep		▲ <sup>6</sup>	▲ <sup>3</sup>									
Evaluate / Negotiate			▲ <sup>3</sup> ▲ <sup>17</sup>									
Award Options Contract			▲ <sup>21</sup>									
Options Assessment Phase			▲ <sup>21</sup>	IPR	IPR		▲ <sup>21</sup>					
Release Draft GBI RFP				▲								
OSD Review						▲ <sup>20</sup>	▲ <sup>21</sup>					
Release GBI RFP							▲ <sup>4</sup>					
Industry Proposal Prep							▲ <sup>4</sup>		▲ <sup>20</sup>			
Evaluate Proposal								▲ <sup>20</sup>			▲ <sup>31</sup>	
Negotiate											▲ <sup>31</sup>	▲ <sup>23</sup>
Award GBI Contract												▲ <sup>23</sup>



# NMD FY 92 MASTER SCHEDULE

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
USSPACECOM Reviews (SWAAT)			▲ <sup>5</sup>		▲ <sup>25</sup>		△ <sup>28</sup>				△	
GPALS BM / C <sup>3</sup> ORD								Submit △ <sup>30</sup>		Validate △ <sup>30</sup>		
NMD ORD											Submit △ <sup>31</sup>	
SDIO GPALS / NMD Reviews			SRR ▲ <sup>18-19</sup>			IPR △ <sup>24-25</sup>				△ SDR		
ERIS FTV-2 / KITE 2A						△				△		
DAB / SSC		▲ <sup>5</sup>			▲ <sup>20</sup>				△ <sup>1</sup>		29 △	
POM												
- Base CARDS				▲ <sup>15</sup>								
- NMD Working Group Changes					▲ <sup>13</sup>							
- BCE / ICE							△ <sup>16</sup>					
- Review (PRB)							△ <sup>7-9</sup>					
- Submission								△ <sup>1</sup>				
Congressional Descriptive Summaries				▲ <sup>10</sup>			△ <sup>17</sup>					
180 Day Report To Congress				v 1.0 ▲ <sup>23</sup>	v 2.0 ▲ <sup>6</sup>	v 3.0 △ <sup>10</sup>	NMD / TMD △ <sup>15</sup>			Submission △ <sup>6</sup>		



# CRITICAL FACTORS FOR DEPLOYMENT

---

- **Integration**
- **Producibility**
- **Supportability**
- **Risk Control**



# SYSTEM / SEGMENT INTEGRATION RISK REDUCTION MEASURES

---

- **Integrated Management Structure**
- **Design For Testing**
- **Iterative Design Analyses**
  - **Product Design Specifications**
  - **User's Manuals**
- **Integrated Test Plans**
  - **All Contractor Tests**
  - **All Subcontractor Tests**
- **Failure Reporting System**
- **Failure Review Board**
- **Uniform Test Reporting**
- **Technical Risk Assessment System Integrated With C / SCSC**
- **Continuously Test, Analyze, And Fix**



# NMD ELEMENT CONTRACTS AND SYSTEM / SEGMENT INTEGRATION CONTRACT

---

- **Specification**
- **Contract Line Items / Clauses**
- **Statement Of Work**
- **Integrated Master Plan /  
Integrated Master Schedule**
- **Work Breakdown Structure**
- **Contract Data Requirements List**
- **Technical Performance Measures**
- **Cost / Schedule Control System**
- **Award Fee Plan**



**Integrated  
Management  
Structure**





# INTEGRATED MANAGEMENT STRUCTURE

**Objective: Contractor Plans / Commits To Executable Program;  
Contractor Manages To His Plan; Government  
Evaluates And Rewards Performance**

**Requirements**

Functional System Specification

**Work Breakdown  
Structure (WBS)**

Tailored To Development / Manufacturing Process  
Outline Of Entire Program

Single Numbering System (Spec Tree / SOW / IMP / Award Fee Plan)

**Statement Of Work (SOW)**

Guidance Provided In Request For Proposal  
Contractor Generated

**Integrated Master Plan (IMP)**

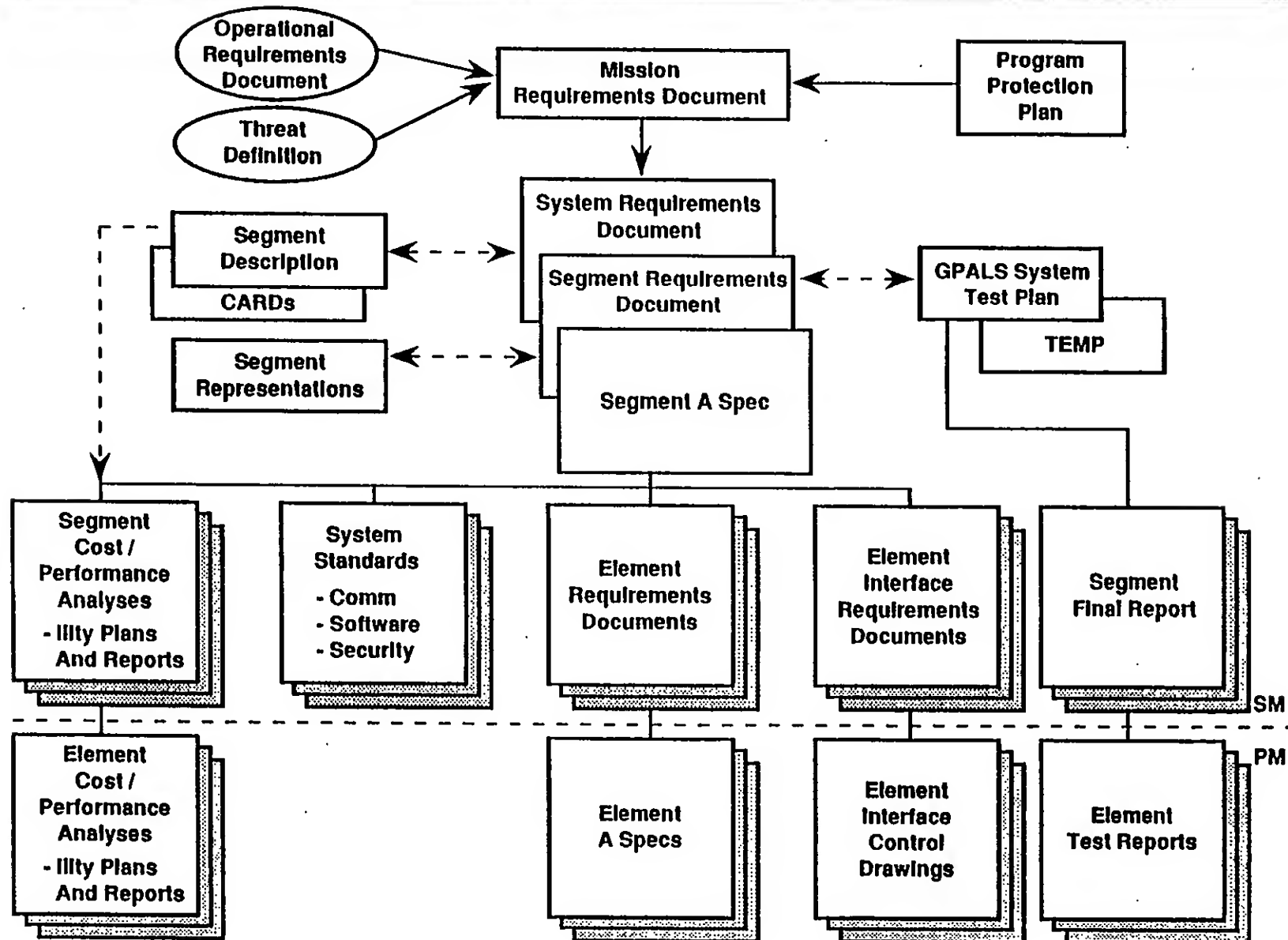
Event Driven Plan  
Details Significant  
Accomplishments  
And Success Criteria

**Award Fee Plan**

Tied To IMP And Accomplishments



# DEFINITION AND CONTROL OF SEGMENT DESIGN BASELINE





# NMD PRODUCIBILITY

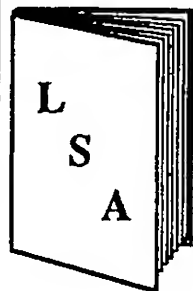
---

- **Integral To The Engineering Process**
- **Manufacturing Process Qualification = Design Performance Qualification**
- **Configuration Control Program**
  - **Product Baseline**
  - **Production Process Baseline**
  - **Subcontractors And Vendors**
- **Formal Piece Part Control Program**
- **Defect Control Program**



# NMD SUPPORTABILITY

## Logistics Support Analysis



- Integral To The Engineering Process
- Critical For Developing
  - Maintenance Concepts (2 vs 3 vs 4 Levels)
  - Built-In Test Design
    - Reliability Requirements
    - Maintainability Requirements
  - Supply Support To Meet A<sub>0</sub>

**Supportability Impacts GPALS /  
NMD Operational Availability And  
Readiness**



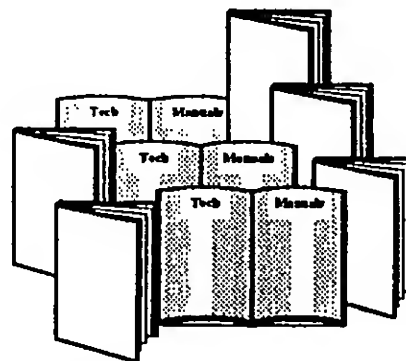
## Manpower And Personnel

- Skill Requirements To Be Identified Early
  - Operational Requirements Documents
  - Development Specifications
- Limitations Factored Into Design



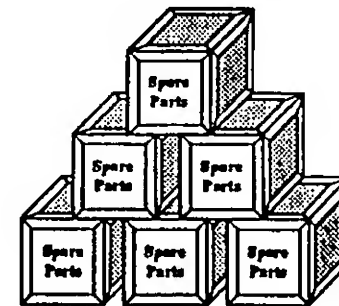
## Training & Training Devices

- Configuration Consistency With
  - As Built Elements
  - Technical Manuals
- Built-In Capability For On The Job Training



## Technical Manuals

- Configuration Consistent With
  - As Built Elements
  - Training And Training Devices
- Verification Included In Testing

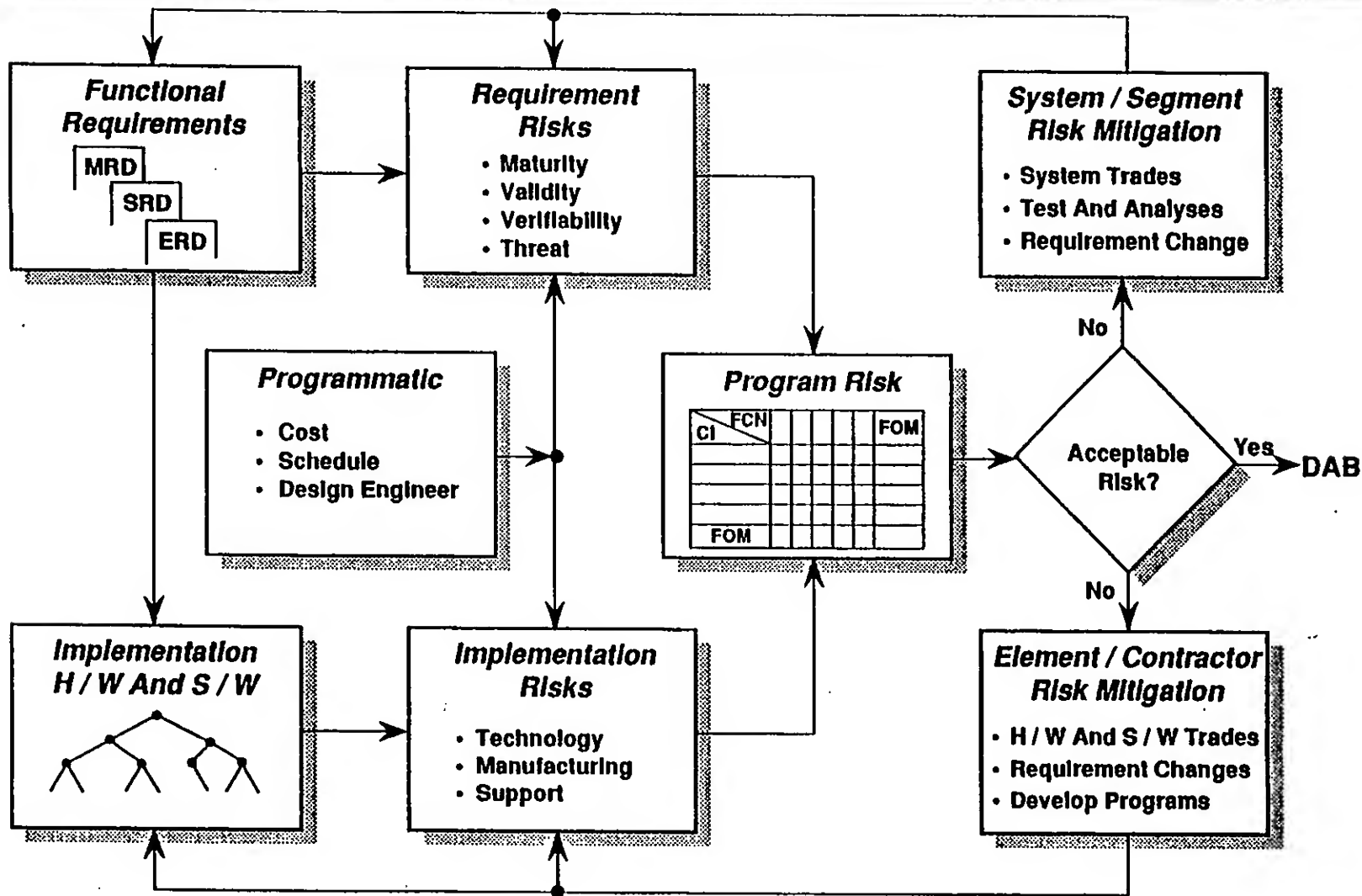


## Spares

- Stockage Allowances Engineered To Optimize Operational Availability
- Production Concurrent With Element To Reduce Unit Cost
- Transition To Government Spares Support



# RISK ASSESSMENT AND MITIGATION PROCESS



Systematic Process For Assessing, Prioritizing And Resolving All Risks Associated With The Definition (Requirements) And Implementation (H / W And S / W) Of The System



# SUMMARY

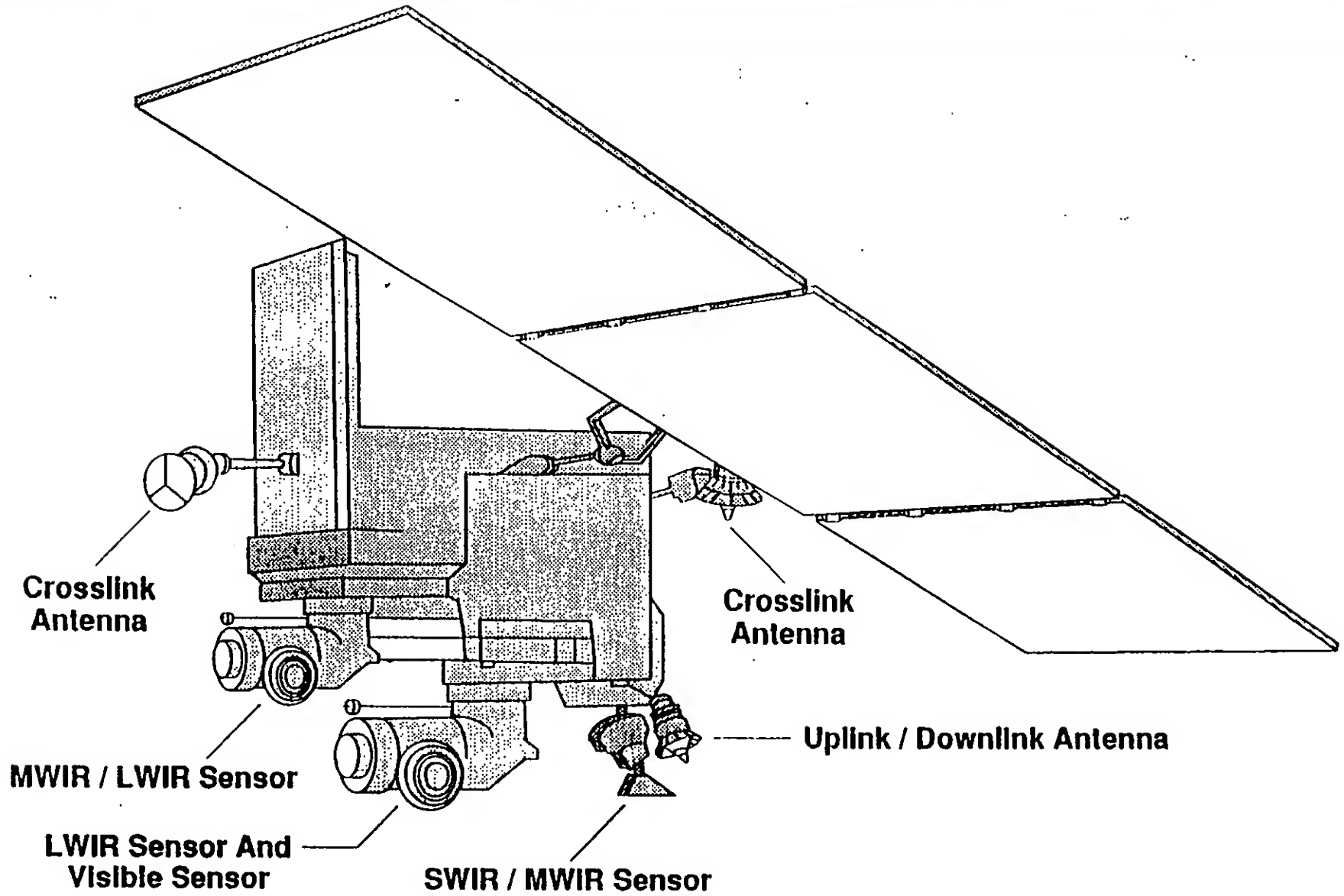
---

- **NMD Segment Can Be Deployed Incrementally**
- **NMD Meets The Initial Deployment Mandate In The 1991 Missile Defense Act**
- **Producibility And Supportability Are Key Factors For Fielding Equipment That Is Suitable, Supportable, And Sustainable By Military Operators / Maintainers**
- **NMD Success Depends On User / Developer / Contractor Teamwork**

**BACK-UP**



# BRILLIANT EYES







# BRILLIANT EYES SPACE BASED SURVEILLANCE SATELLITES

## Description

- Highly Distributed
- Low Earth Orbit
- Small, Lightweight (<450 kg)
- Narrow Field Of View Sensors
- SWIR, MWIR, LWIR And Visible Sensors

## Contractors

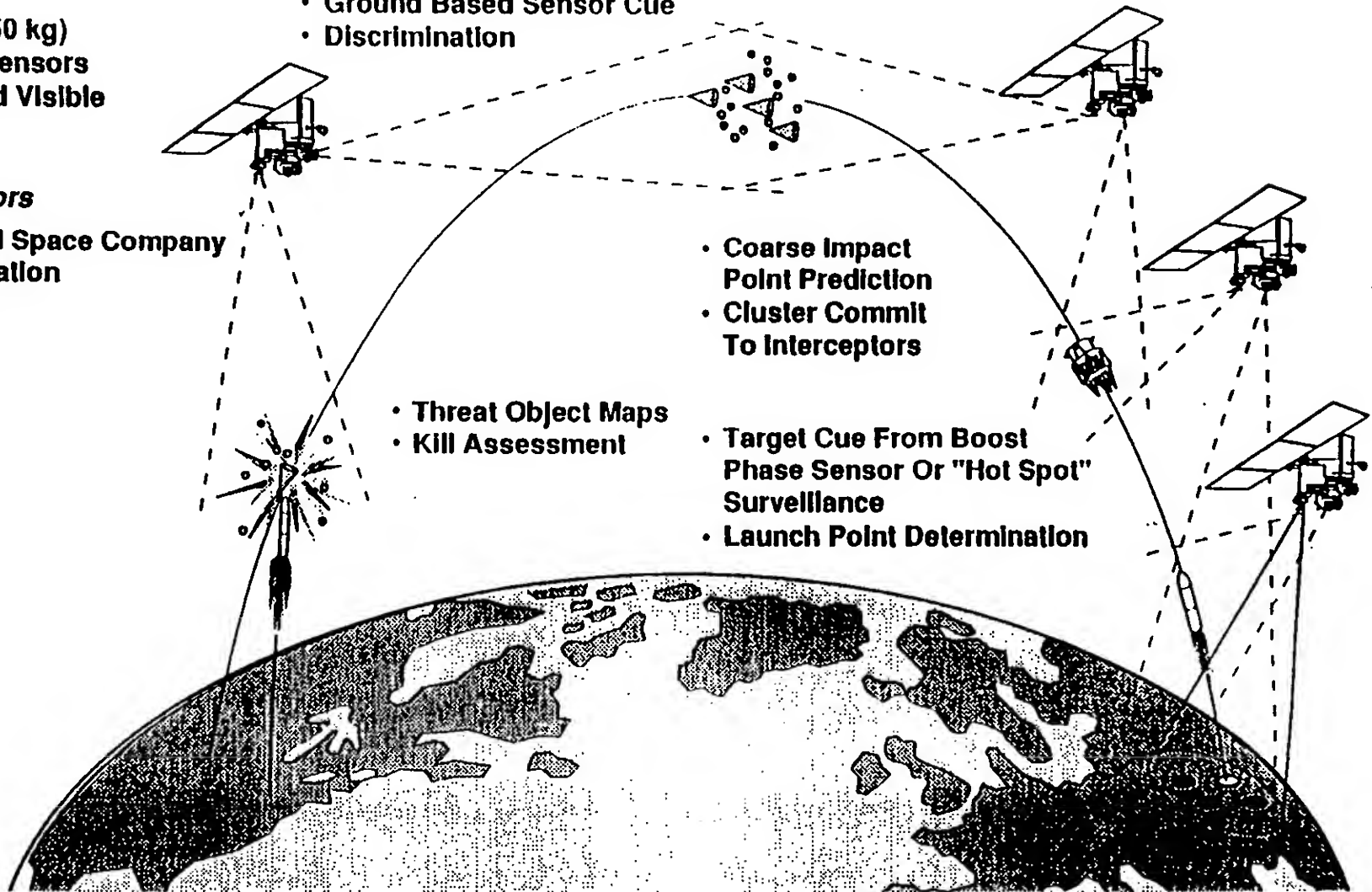
- Lockheed Missiles And Space Company
- Martin Marietta Corporation
- Rockwell International
- TRW, Inc

- Fine Impact Point Prediction
- Weapon / Target Assignments
- Inflight Target Updates
- Ground Based Sensor Cue
- Discrimination

- Coarse Impact Point Prediction
- Cluster Commit To Interceptors

- Threat Object Maps
- Kill Assessment

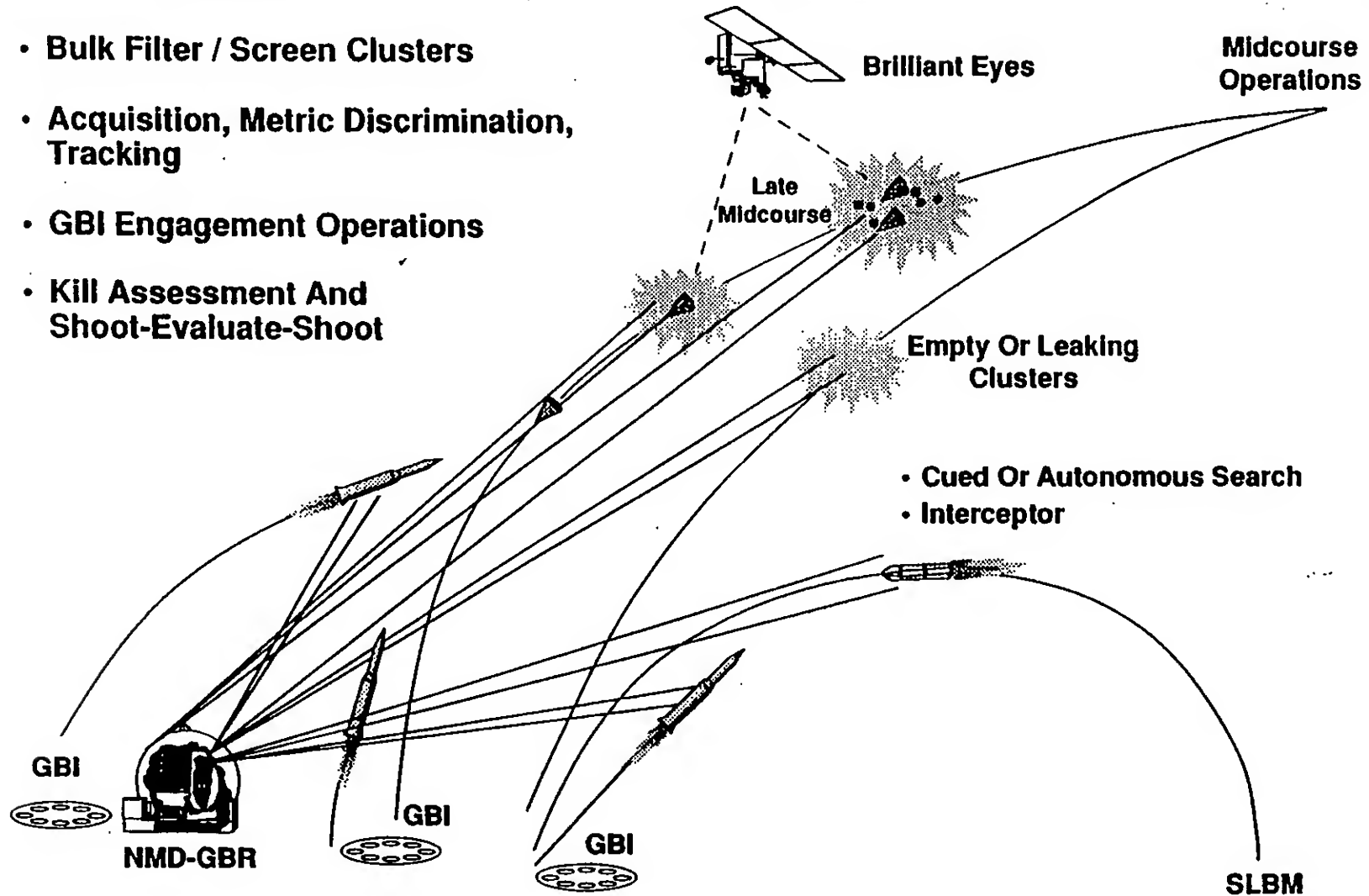
- Target Cue From Boost Phase Sensor Or "Hot Spot" Surveillance
- Launch Point Determination





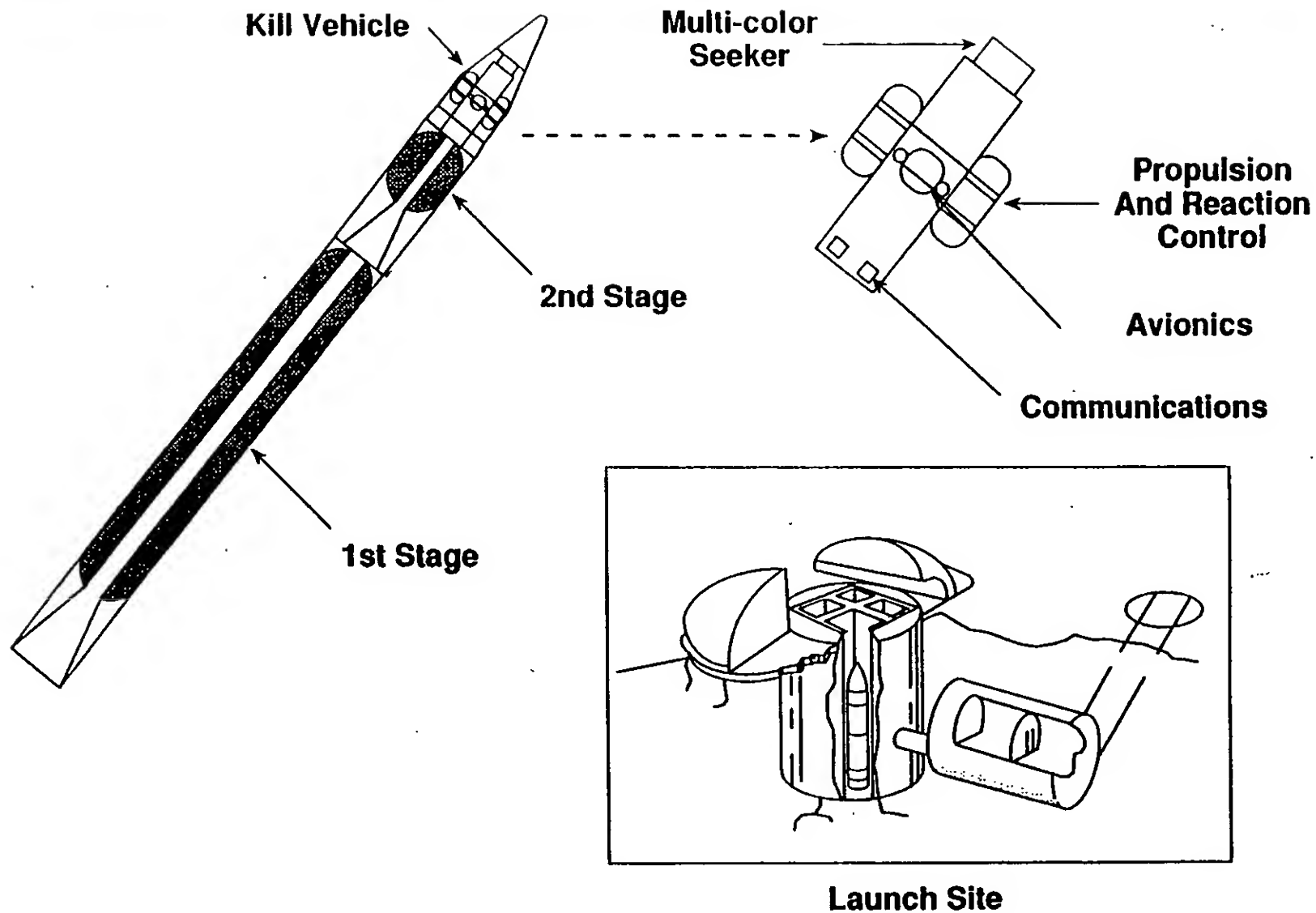
# NMD-GBR CONCEPT OF OPERATIONS

- Autonomous Search Or Cued By Other Sensors
- Bulk Filter / Screen Clusters
- Acquisition, Metric Discrimination, Tracking
- GBI Engagement Operations
- Kill Assessment And Shoot-Evaluate-Shoot





# GBI



F  
FOI 92-0855

# THEATER MISSILE DEFENSE



*Brail*

**Theater Missile Defense Deputate  
Strategic Defense Initiative Organization**



# TOPICS

---

- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**
- **Technical Activities**
  - **System Acquisition**
  - **Architecture And Analyses**
  - **Experimental Support**
  - **Special Projects**
- **Programmatics**



# TERMINOLOGY

---

- ***Theater And Tactical Are Used Interchangeably***
- ***Theater Missile Or Tactical Missile Refers Herein To Ballistic Missiles***



# THEATER MISSILE DEFENSE HISTORY

---

- **1984 And Subsequent SDIO Charters Included Authority To Conduct Theater Missile Defense Research**
- **SECDEF Guidance In 1986 Directed SDIO To Explore Specific Ways (Its) Research Can Support NATO Extended Air Defense Efforts**
- **Prior To FY 91, SDIO's TMD Efforts Were Directed To Technology Demonstrations And Architecture Studies**
- **FY 91 Congressional Direction: Centrally Manage And Accelerate TMD Efforts**
- **SDIO Identified As Central DoD Manager For TMD In November 1990**



## CONGRESSIONAL DIRECTION

---

### *Conference Report On FY 91 Appropriations*

**". . . A U.S. Tactical Ballistic Missile [Defense] System With The Necessary Capabilities Should Be Fielded As Soon As Technologically And Fiscally Feasible."**

**"[Include] As Appropriate . . . The Navy And Air Force Requirements For Tactical Ballistic Missile Defense Systems And Programs."**

### *Authorization Act (Sec. 225) For FY 91*

**It Is The Sense Of Congress To "Ensure That The Navy And Marine Corps Are Involved In Development Programs For Future ATBM Systems Suitable For Deployment With Their Projection And Expeditionary Forces."**





## CONGRESSIONAL DIRECTION

---

### *Conference Report On FY 91 Appropriations*

**". . . A U.S. Tactical Ballistic Missile [Defense] System With The Necessary Capabilities Should Be Fielded As Soon As Technologically And Fiscally Feasible."**

**"[Include] As Appropriate . . . The Navy And Air Force Requirements . . ."**



## PRESIDENTIAL DIRECTION

---

**"... Looking Forward, I Have Directed That The SDI Program Be Refocused On Providing Protection From Limited Ballistic Missile Strikes, Whatever Their Source. Let Us Pursue An SDI Program That Can Deal With Any Future Threat To The United States, To Our Forces Overseas And To Our Friends And Allies."**

***President George Bush  
State Of The Union Address  
29 JAN 91***



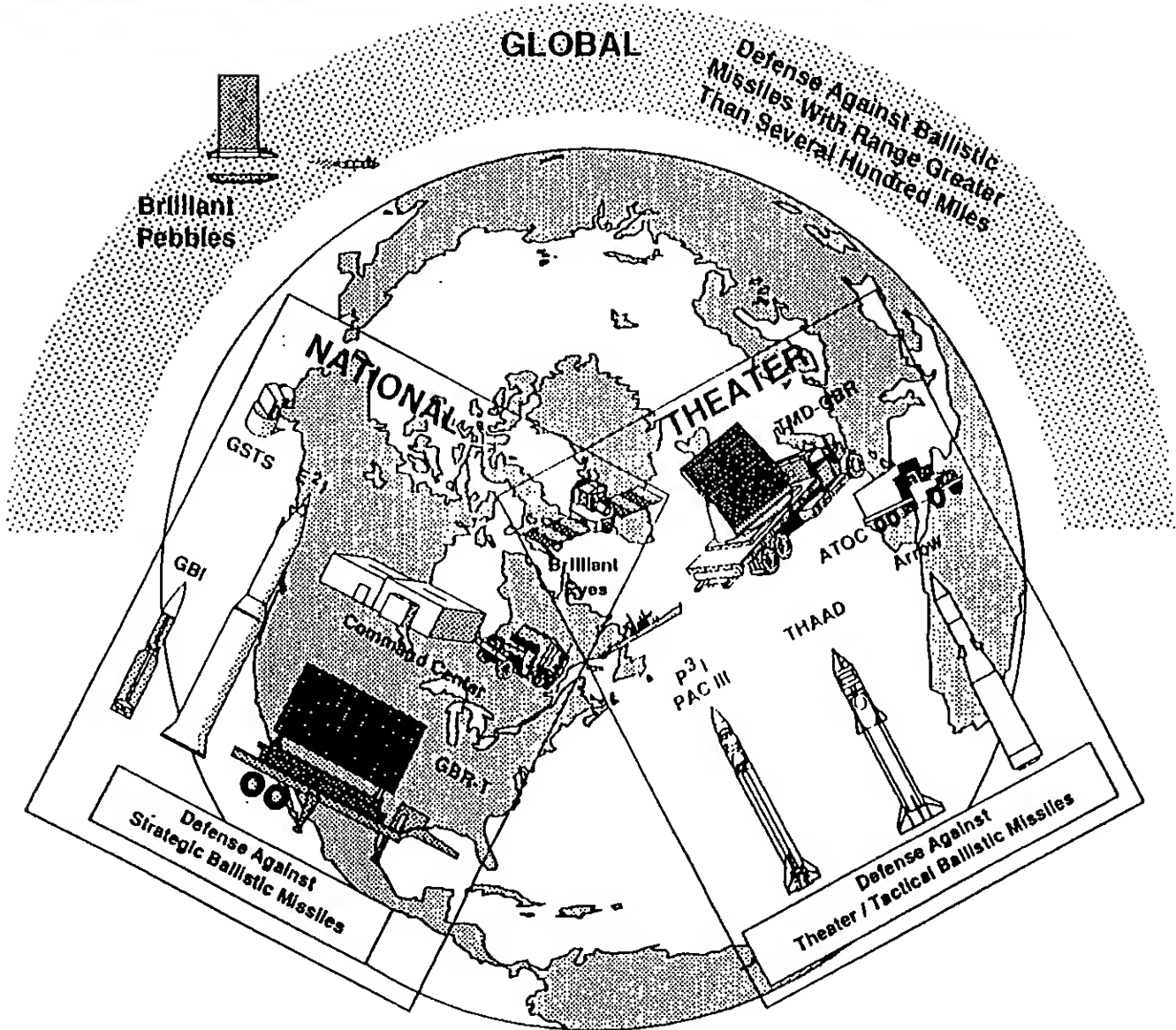
## DIRECTION AND GUIDANCE

---

- **Secretary Cheney Statement Before The Senate Armed Services Committee Feb 21, 1991: "... SDIO Has Been Charged With Developing Advanced Defensive Technologies To Deploy Much Improved, Transportable Theater Missile Defenses Within The Next Five Years"**
- **Missile Defense Act Of 1991**
  - **"Aggressively Pursue The Development Of A Range Of Advanced TMD Options, With The Objective Of Down Selecting And Deploying Such Systems By The Mid-1990s."**
  - **"...To Achieve The Mid-1990s Deployment Date For A Theater Missile Defense System, Acceleration Of Normal Acquisition Process And Procedures Is Required In Light Of The Very High Priority Of These Objectives."**

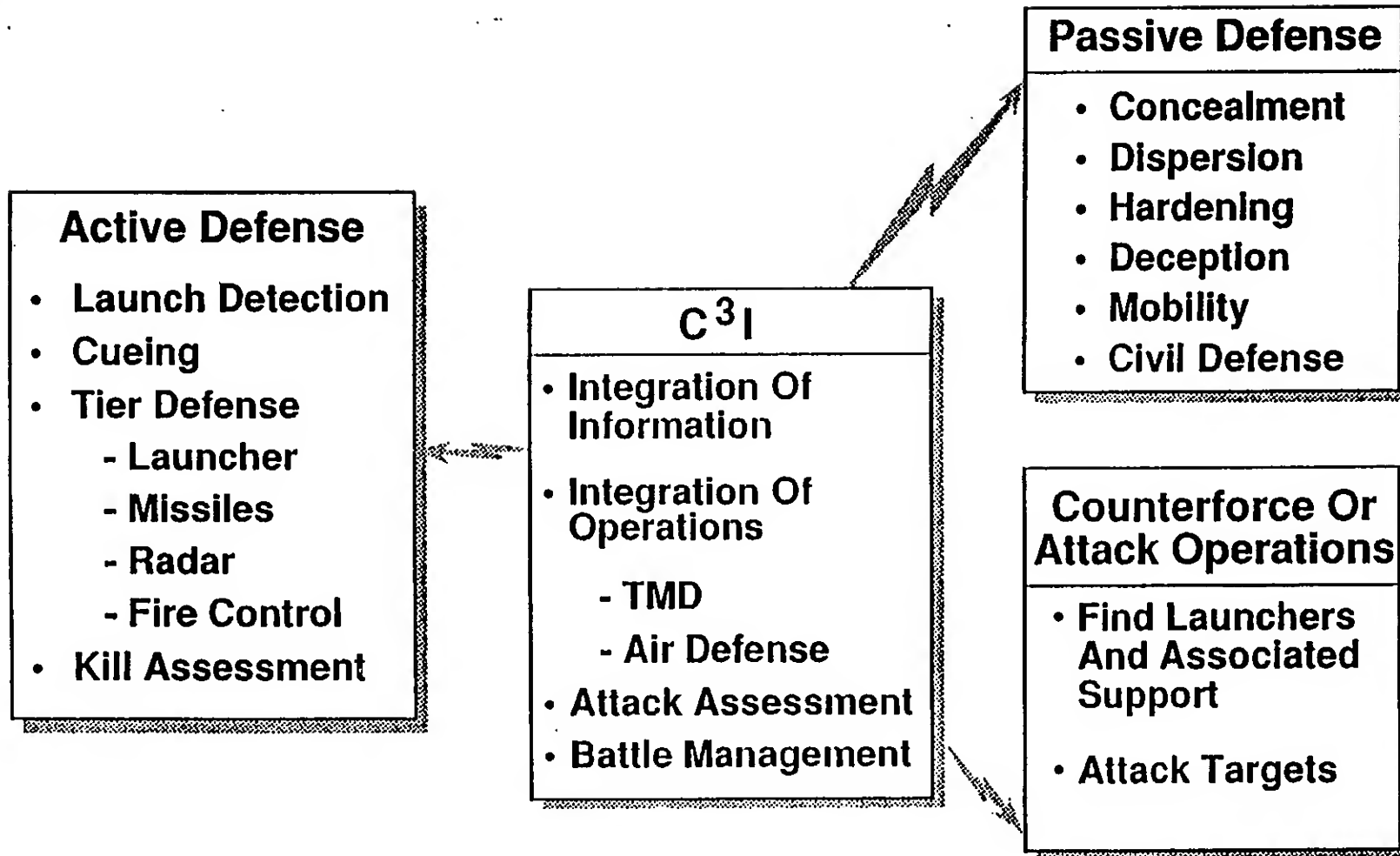


# GPALS





# TMD FUNCTIONS





## **SDIO's TMD MISSION**

---

- **Part Of GPALS, But Early Stand-alone Capability**
- **Active Defense And Associated C<sup>3</sup>I**
  - **Early (Boost Phase) Intercepts**
  - **High-altitude Midcourse Intercepts**
  - **Low Leakage**
  - **Protect Areas (Population) And Assets**
- **Integrate And Balance Among All Pillars**
- **Integrate TMD And Air Defense, Including Cruise Missile Defense**



# TOPICS

---

- **Background**



- **Requirements And Threat**



# JCS MISSION AREA NEEDS STATEMENT

---

- **"Theater Missile" Includes Ballistic, Cruise, And Air-To-Surface Types**
- **Protect U.S. Forces, U.S. Allies And Other Important Countries Including Areas Of Vital Interest To The U.S., From Theater Missile Attack**
- **Conventional, Chemical, Biological And Nuclear Warheads**
- **Four Mission Areas**
- **Mix Of Land, Air, Sea, And Space Capabilities**
- **C<sup>3</sup>I Should Be Incorporated Into Existing Structures**
- **"Defense In Depth" With Multiple Shot Opportunities**
- **C-130 Deployable**
- **No Quantitative Information**





## TMD THREAT

---

- **Extent**

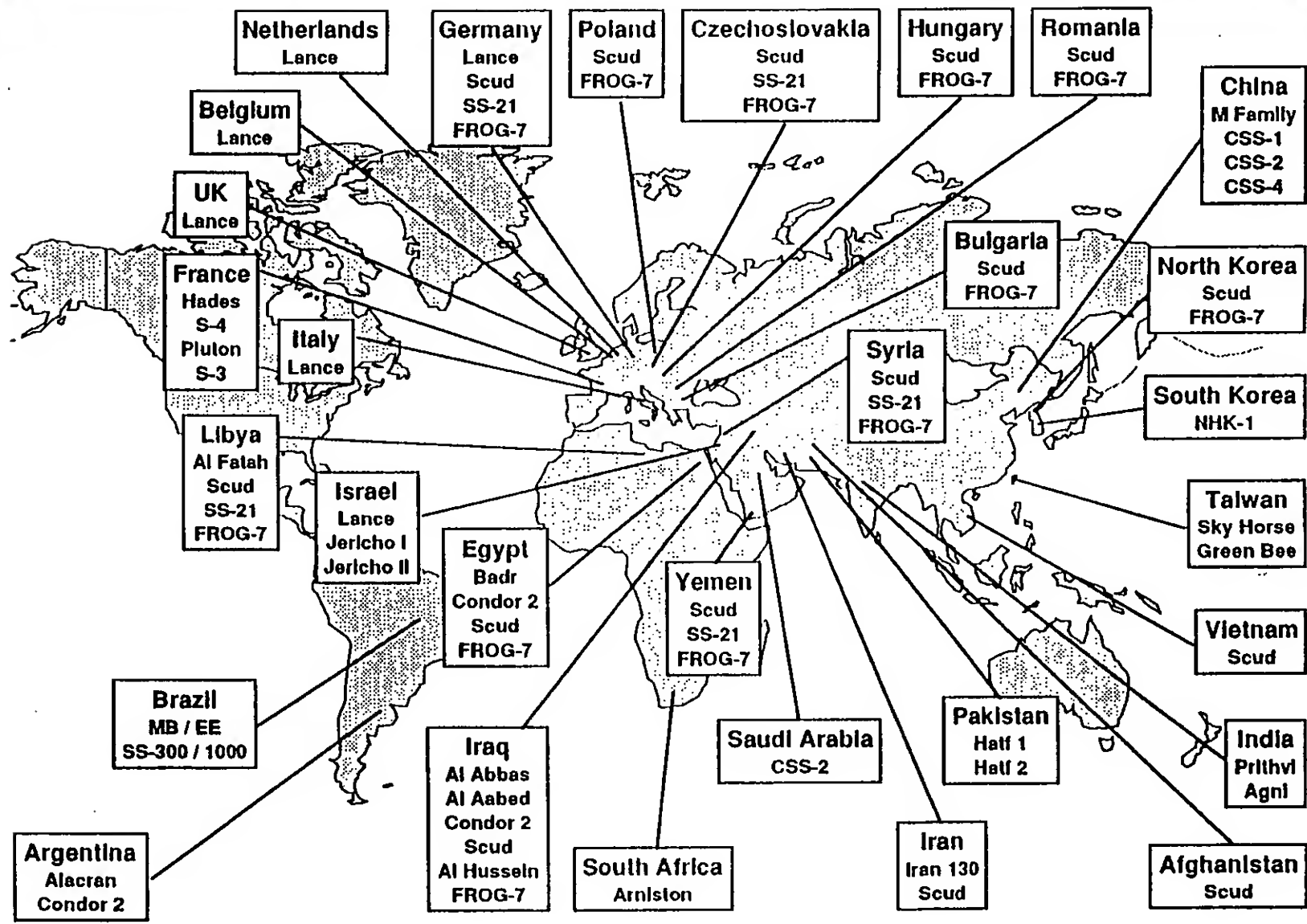
- Countries With TBMs
  - Different TBM Designs
  - Existing Launchers
  - Existing Missiles
- } 10s
- 100s
- 1000s

- **Characteristics**

- Ranges 80 - 3000 km
- Apogees 20 - 150 km
- Velocities 1 - 4 km/sec



# EVOLVING BALLISTIC MISSILE CAPABILITY





# FUTURE DEVELOPMENTS AFFECTING BALLISTIC MISSILE CAPABILITY

---

- **Range**
- **Accuracy**
- **Payload**
  - **Warhead**
  - **Packaging**
- **Countermeasures And Decoys**
- **Indigenous Production**



# TMD THREAT WARHEADS CONSIDERED

---

- **Bulk High Explosive**
- **High Explosive Submunitions**
- **Bulk Chemical Munition**
- **Chemical Submunition**
- **Bulk Agent Of Biological Origin (ABO)**
- **ABO Submunition**
- **Soviet Nuclear**
- **Third World Nuclear**



## TMD COUNTERMEASURES

---

- **Separating Warhead**
- **Fragmenting Booster**
- **Standoff Jammer**
- **Escort Jammer (X-band)**
- **RCS -  $\beta$  - Matched Decoys**
- **Low RCS RV**
- **IR Decoy / Flares**



# TOPICS

---

- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**





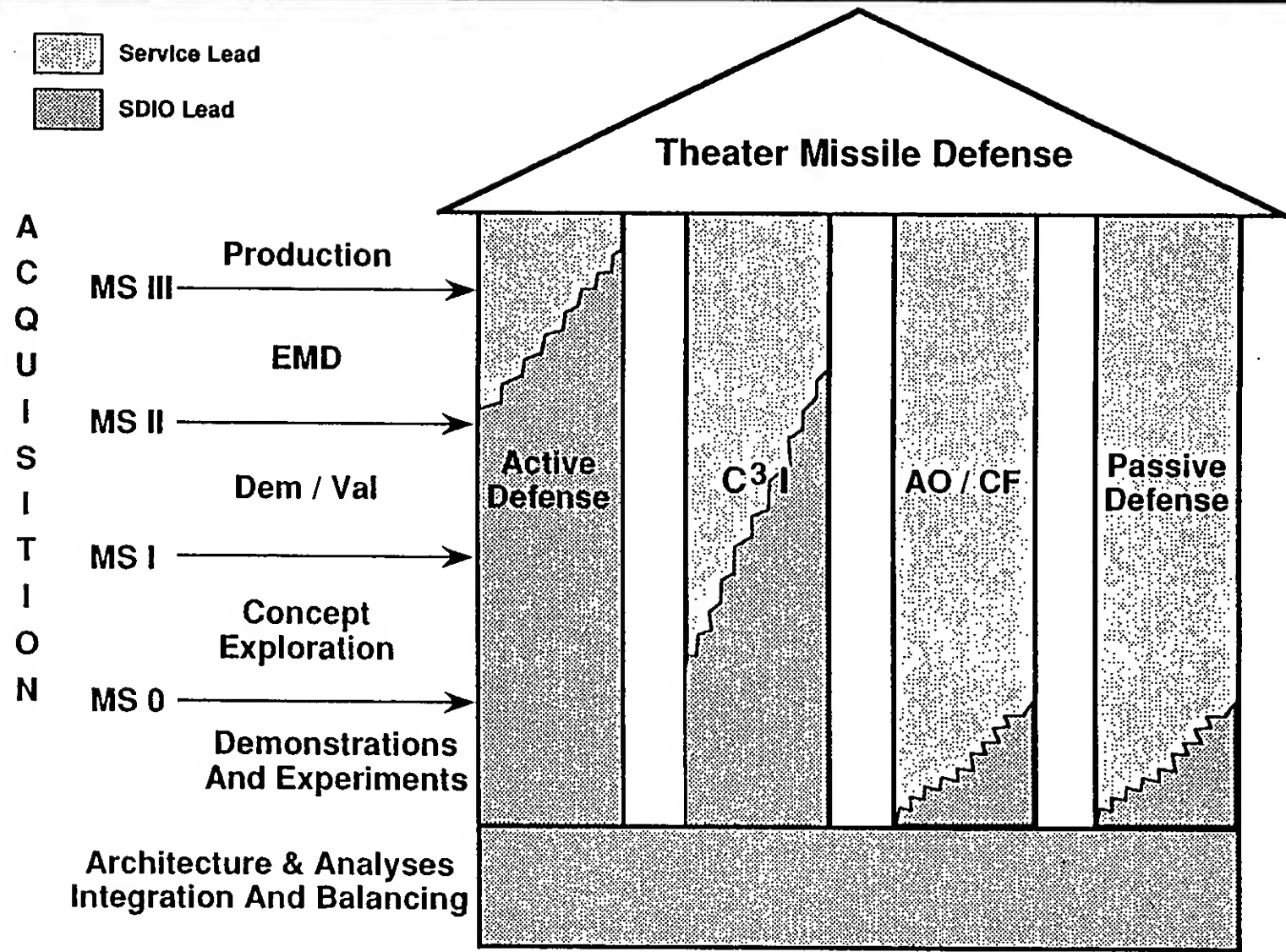
# APPROACH

---

- **Priority To Near-term Improvement Of Active Defense**
- **Flexible / Modular Approach For Range Of Deployments**
  - **Mature Theater**
  - **Immature Theater**
- **Multiservice Involvement**
- **Activities Across Four Pillars Of TMD**
- **Scope**
  - **Architecture And Analyses**
  - **Experimental Support**
  - **Acquisition**
- **International Participation**



# SDIO ROLES







# SDIO TMD PROGRAM

<b>Pillar</b> <b>Category</b>	<b>Active Defense</b>	<b>C<sup>3</sup>I</b>	<b>AO / CF</b>	<b>Passive Defense</b>
<b>Architecture And Analyses</b>				
<b>Experimental Support</b>				
<b>System Acquisition</b>				
<b>Special Projects</b>		<b>As Required</b> →		



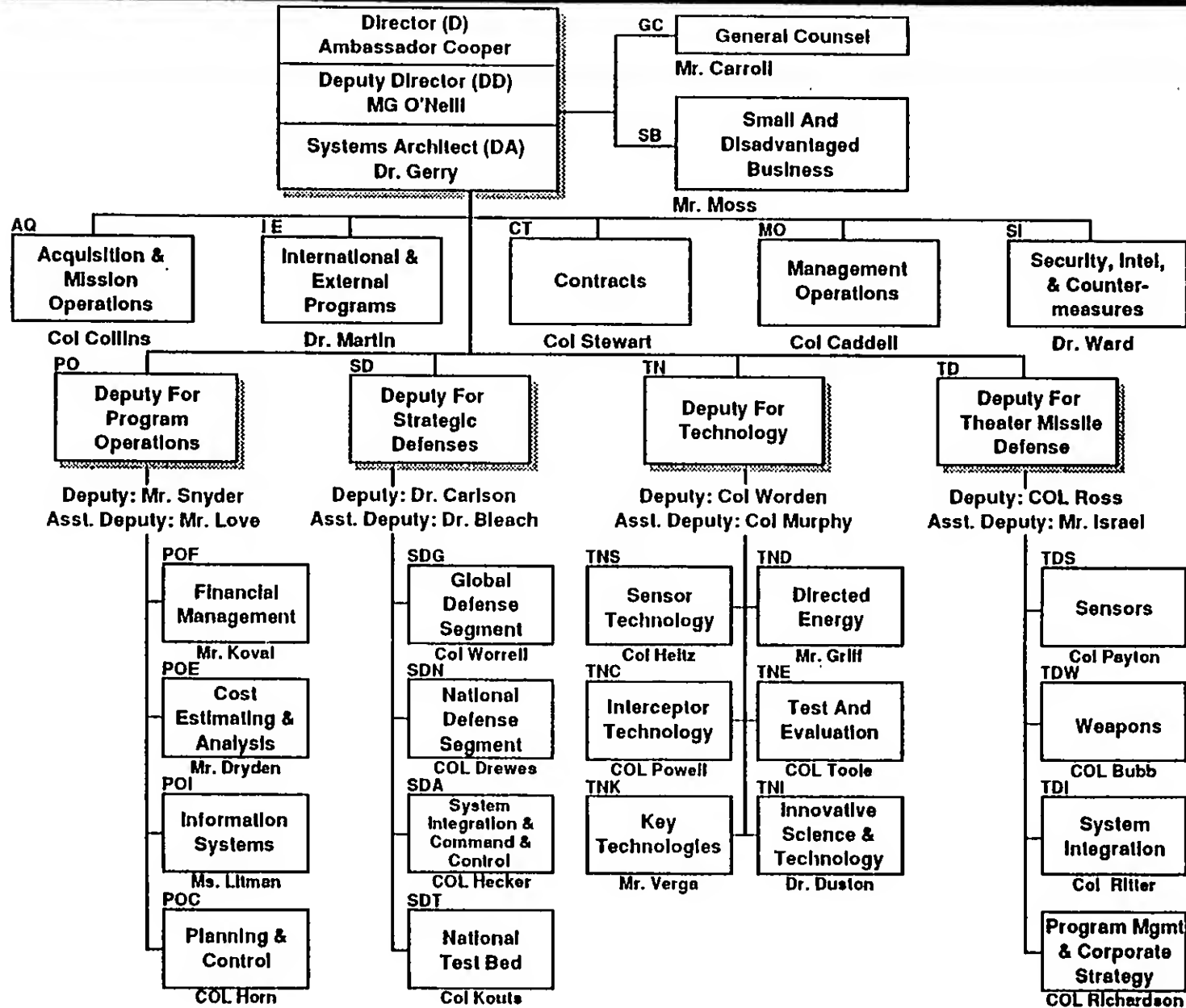
# ROLES

---

- **SDIO**
  - **Central TMD Manager For DoD**
  - **Source Of Funding**
  - **System Engineering And Program Direction**
  
- **Services**
  - **Combat Development**
  - **System Acquisition**
  - **Contracting**
  - **Technology Development**

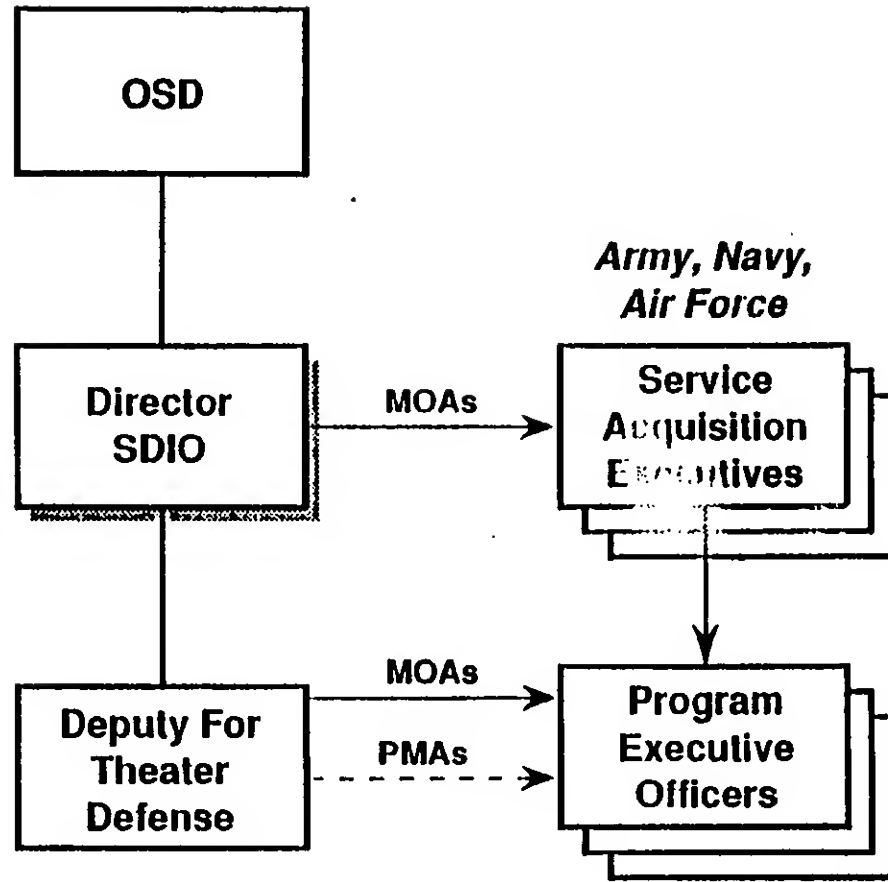


# STRATEGIC DEFENSE INITIATIVE ORGANIZATION



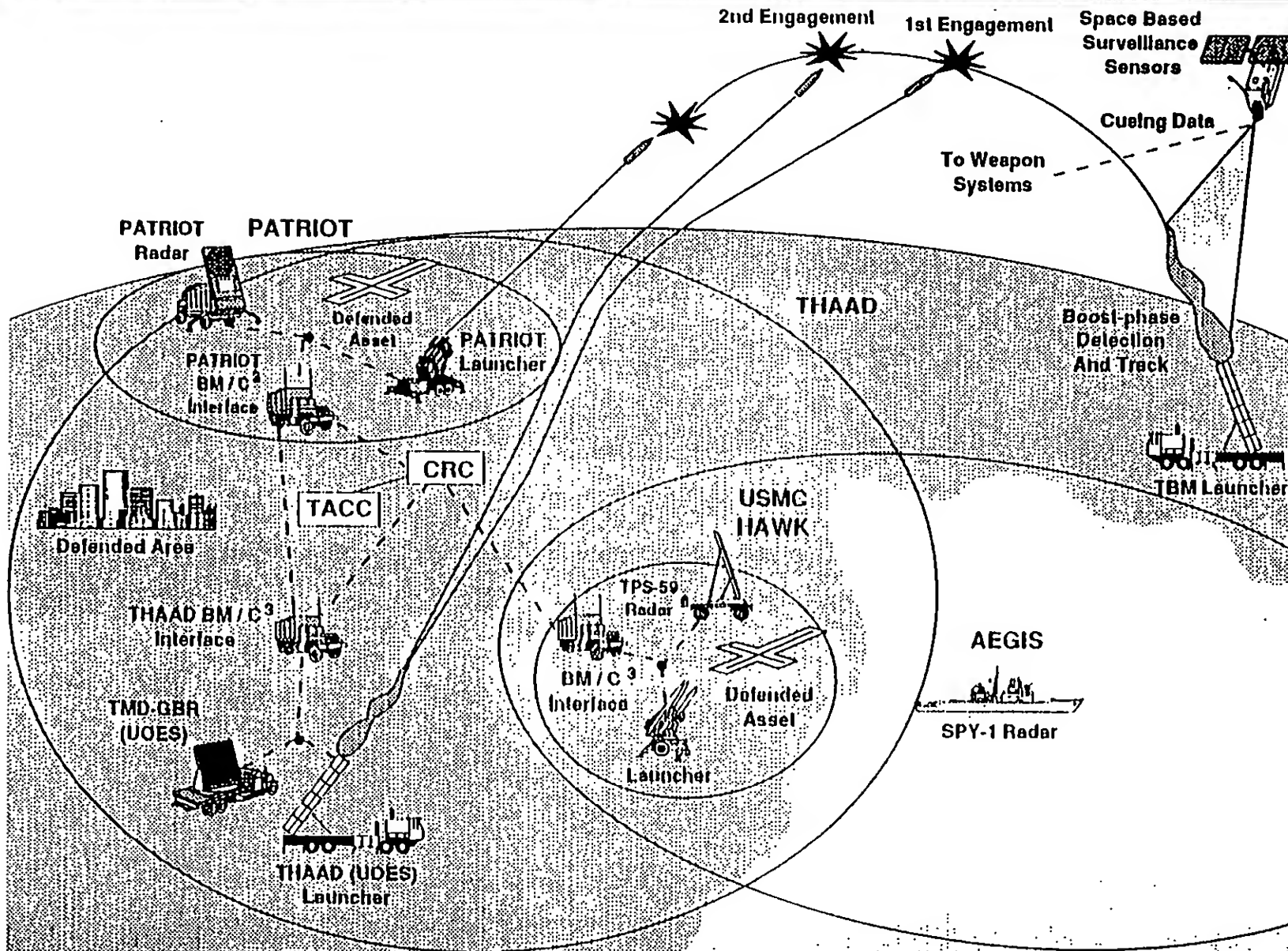


# TD MANAGEMENT



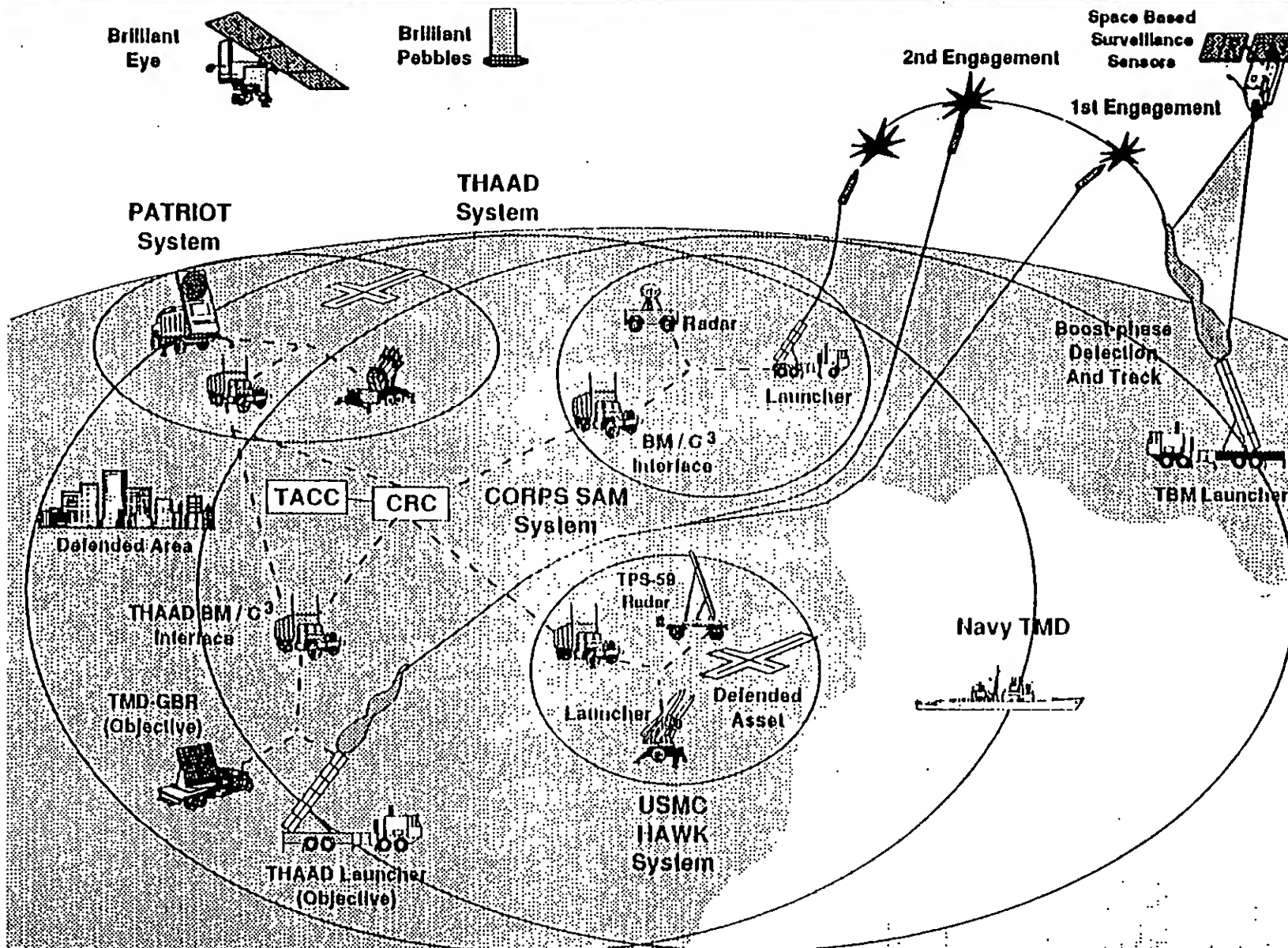


# NEAR TERM TBMD ACTIVE DEFENSE BASELINE ARCHITECTURE





# FAR TERM TBMD ACTIVE DEFENSE BASELINE ARCHITECTURE





## KEY STUDIES

---

- **Defense Science Board**
- **JASON**
- **Navy Studies**
- **Architecture Integration Study**
- **POET Summer Studies**



## **DSB / DPB**

---

- **Upgrade PATRIOT Quickly**
- **Lethality Unknowns Merit Attention**
- **Pursue Advanced System (THAAD And TMD - GBR)**
  - **Consider Heavier Warhead**
- **Consider Important Navy Role**
- **Space Can Make Contributions**
- **Management Attention Required**





# POET SUMMER STUDIES

---

- **Launch Detection**
- **Midcourse Sensing (BEAMS)**
- **Counterforce**
- **Advanced Technology**



# INTERNATIONAL INTEREST

---

- **Israel**
  - Mid East Architecture Analysis
  - Arrow / ACES
  - ETG / HVG
  - Test Bed
  - Lethality
- **United Kingdom**
  - Evaluate Theater Strategic Threat
  - Cooperative Program In KBS / AI / Sensors / Test Beds
  - UK Architecture Study
- **Japan**
  - Awareness Of Problem (WESTPAC)
  - PATRIOT Improvements
  - MSAM / CHU SAM
  - Test Bed Interest
- **Germany**
  - Awareness Of Threat
  - PATRIOT Improvements / Dual Mode Seeker
  - MSAM CD Studies
  - Test Bed Interest
  - Lethality / HVG
- **France**
  - Awareness Of Threat
  - Developing ASTER With Italy
  - Test Bed Interest
- **Italy**
  - Awareness Of The Threat
  - Test Bed Interest
  - Developing ASTER With France



# TOPICS

---

- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**
- **Technical Activities**
  - **System Acquisition**
  - **Architecture And Analyses**
  - **Experimental Support**
  - **Special Projects**





# TOPICS

---

- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**
- **Technical Activities**
  - **System Acquisition**
    - **THAAD**
    - **TMD-GBR**
    - **PATRIOT**
    - **ERINT**
    - **Launch Detection**





## **BASIC PREMISE FOR ACTIVE DEFENSE**

---

- **Improvement Of Active Defense Capability Is An Urgent, High Priority Matter**
- **Two Tiers Of Active Defense Are Required**
  - **PATRIOT Upgraded, CORPS SAM**
  - **THAAD (Including TMD - GBR)**
- **Improved Launch Detection Is Necessary**



## WHY AN UPPER TIER?

---

- **High Altitude**
  - **Minimize Chemical Damage**
  
- **Large Footprint**
  - **Defense Of Dispersed Assets**
  - **Flexibility Of Deployment**
  - **Reduced Inventory / Force Structure**
  - **Reduced Airlift Requirements**
  
- **Long Range**
  - **Multiple Shots (Shoot-look-shoot)**
  - **Higher Overall System  $P_k$**



## AVIATION WEEK INTERVIEW OF LT GEN HORNER

---

***" I Underestimated The Political Impact Of the Scud... A Lousy Weapon, A Terror Weapon"... A Miscalculation... Defused Only By The Success Of Patriot... Patriot Success Also has Exposed A Hole In The Allied Arsenal, Patriot Is A Point Defense Weapon, Areas To Be Defended In Saudi Arabia Are Concentrated In A Few, Small Clusters. If The Allied Military Targets Had Been Spread Out, There "Wouldn't Be Enough Patriots In The World To Defend" Them All.***

**In 15 To 20 Years, When Very Accurate Missiles With Mass Destruction Warheads Are Available To Third-World Nations, The U.S. Will Need A Regional, Wide Area Air Defense Force To Duplicate On A Grand Scale The Patriot's *"Pivotal Role Of Defanging"* The Scud.**

***Lt Gen Charles A. Horner,  
Commander, U.S. Central Command  
Tactical Air Forces  
Aviation Week And Space Technology  
11 FEB 91***



# TMD ACTIVE DEFENSE

• **OVERLAY**  
(Continuous,  
Worldwide  
Coverage)

Launch  
Detection

Brilliant Eyes  
Brilliant Pebbles

• **UPPER TIER**  
(High  
Altitude,  
Area)

THAAD

TMD-GBR

Navy TMD

• **LOWER TIER**  
(Asset)

PATRIOT

Improved  
PATRIOT

(Maneuver  
Forces)

(HAWK)

TPS-59

CORPS SAM

Today

1992

1995

2000

2005

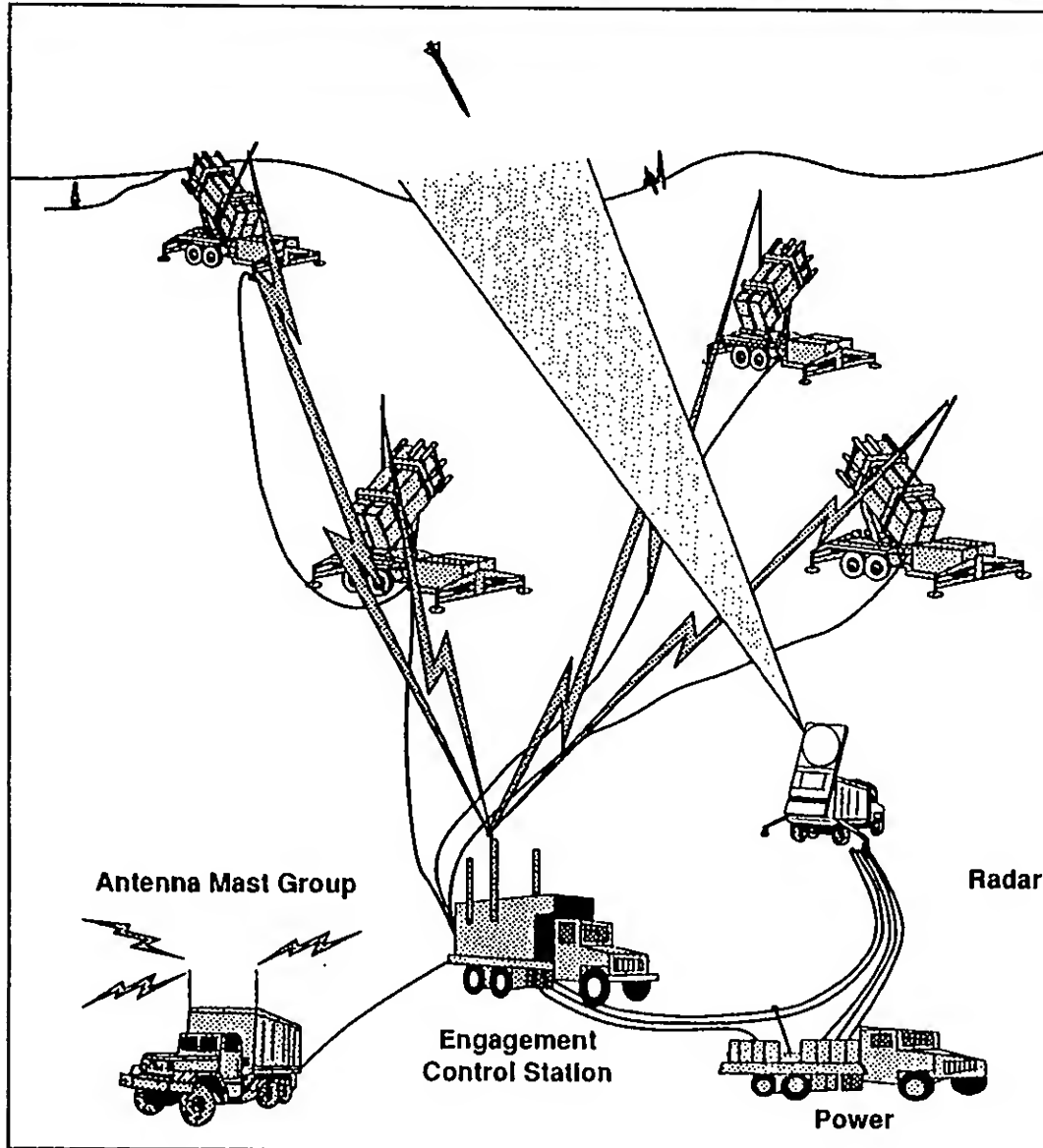
Near Term  
(1996-98)

Far Term  
(2001-03)





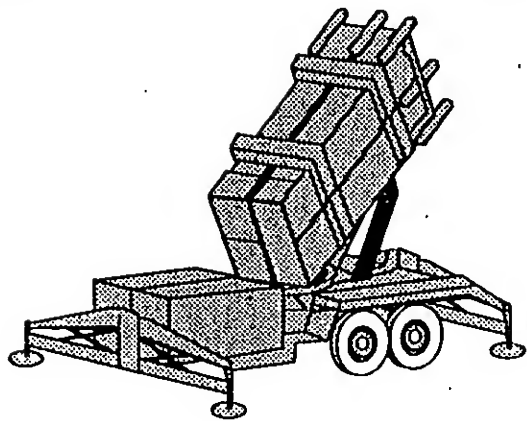
# PATRIOT FIRING BATTERY



- Multifunction Phased Array Radar For Multilaunching Stations
- Multilaunching Stations Mission Dependent (Remote)
- Manned Engagement Control Station (ECS)
- Key Support Equipment
  - Antenna Mast Group
  - Electric Power Plant
  - Fiber Optics Links
  - Cables
  - VHF Radio Data Link



# PATRIOT GROWTH PROGRAMS



### Configuration 3

- Radar Enhancement Phase III
- Multimode Seeker (Full Capability)
- Positive Identification
- Remote Launch (Phase III)
- Out-of-sector Launch
- Battalion Tactical Operations Center (BTOC) / Information Coordination Control (ICC) Integration
- Communication Upgrades
- Launch Point Detection
- Maintenance Equipment

### Configuration 2

- Multimode Seeker
- Improved Propulsion
- Remote Launch (Phase II)
- Improved Launcher
- Positive Identification (Initial Capability)
- Communication Upgrades
  - Communications Processor
  - JTIDS / MSE (BN And Above)
- Counter-antiradiation Missile
- Battalion Tactical Operations Center (BTOC) / Information Coordination Control (ICC) Integration (Initial)
  - Passive Emplacement
  - Air Control Order (ACO) Transfer
- Radar Enhancement Phase II

### Configuration 1

- Expanded Weapon Control Computer
- Optical Disk (Embedded Data Recorder)

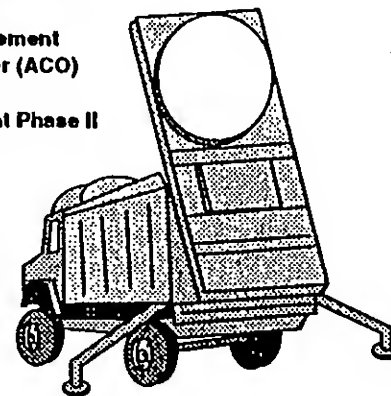
### QRP Configuration

- Remote Launch (Phase I)
- Radar Enhancements (QRP)
- Emplacement Enhancements
- Radar Shroud (Not A QRP Task)
- Missile Guidance Enhancements
- Battalion Tactical Operator Center (BTOC) / Information Coordination Control (ICC) Integration Not QRP Task)

### PAC II

#### Legend

- Red - SDIO Funded
- Green - Army Funded



Today

Future



## ERINT-1

---

- **ERINT-1 Will Demonstrate The Hit-to-kill Capability Of A Small, Low-end atmospheric Interceptor Concept**
- **ERINT-1 Will Demonstrate The Integration Of Unique Technologies**
  - **On-board Active Seeker For Terminal Guidance**
  - **Composite Solid-rocket Motor And Attitude-control Motor Casing**
  - **Combination Of Aerodynamic And Impulsive Control To Achieve Hit-to-kill Accuracy**
- **Achievement Of Program Objectives Will Be Measured In A Series Of Eight Flight Tests**



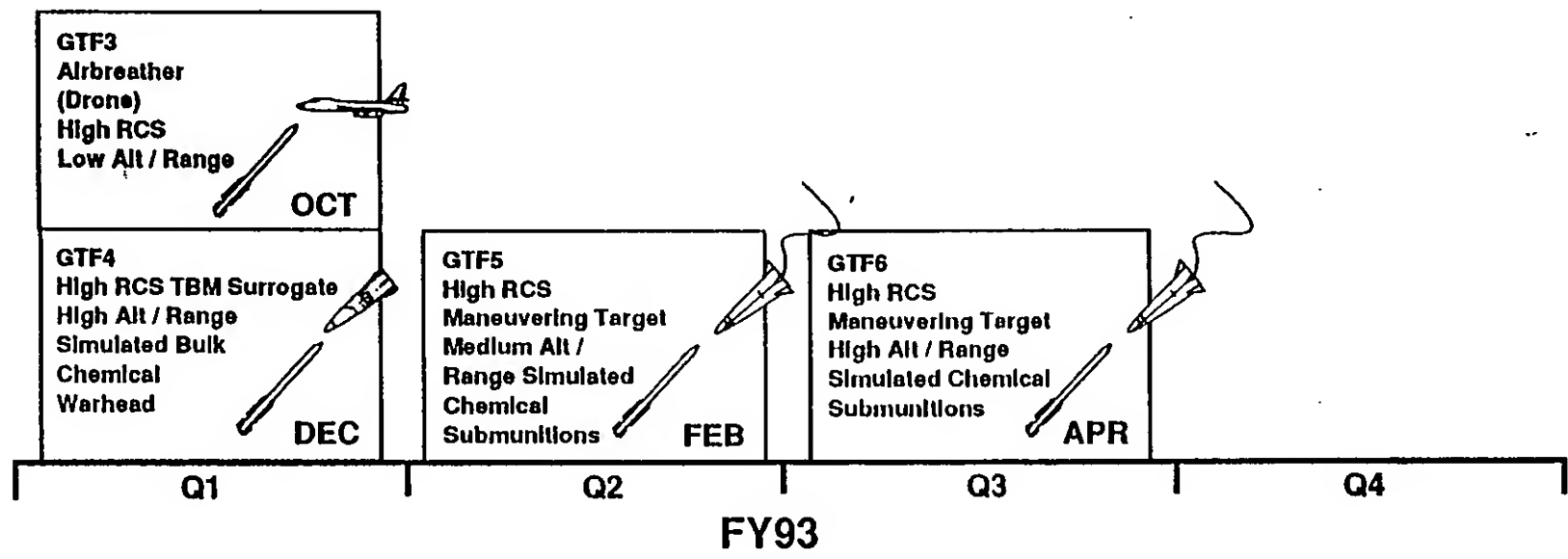
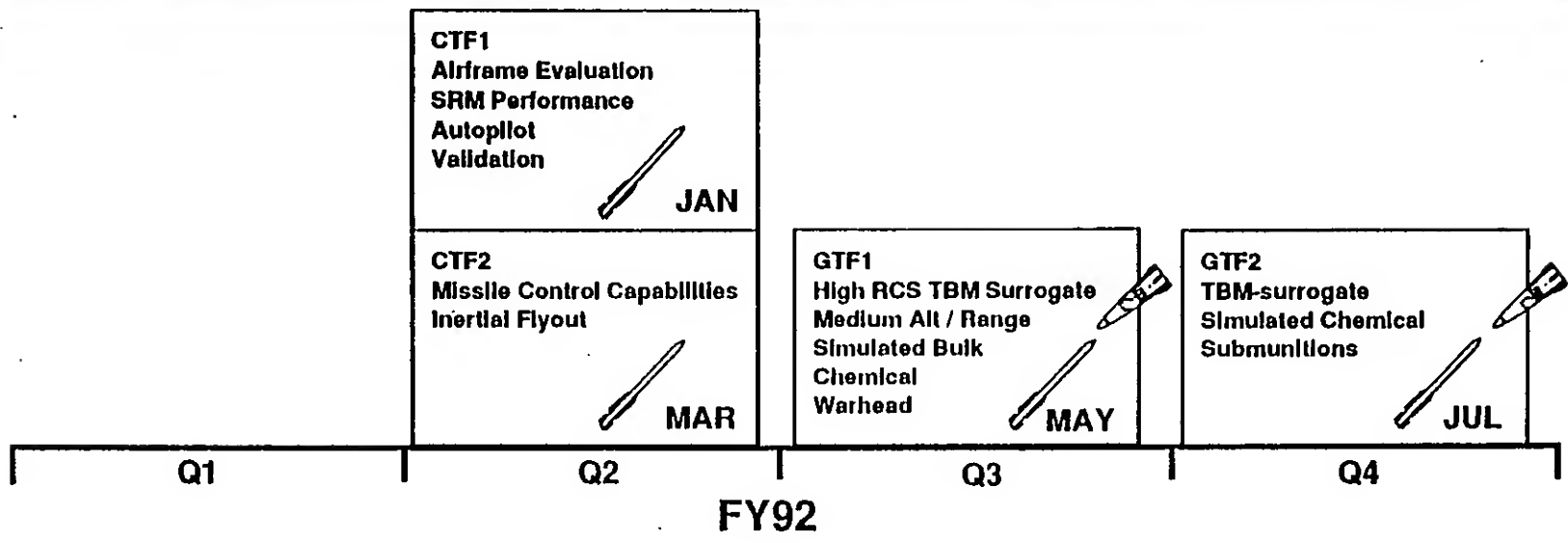
## ERINT-1 CONFIGURATION

**3:1 VON KARMAN RADOME**  
**180 DEG ATTITUDE CONTROL**  
**MOTORS, 12.5 LB-SEC**  
**ONE PIECE RADAR ELECTRONICS**  
**ASSEMBLY**  
**KOROTHERM THERMAL INSULATION**  
**FIBER OPTIC SIGNAL INTERFACE**  
**ACROSS SRM**  
**AERODYNAMIC MANEUVERING**  
**SYSTEM**  
**LENGTH 4475mm**  
**DIAMETER 255 mm**  
**LAUNCH WEIGHT 303.9 Kg**  
**BURNOUT WEIGHT 135.9 Kg**





# ERINT-1 FLIGHT TESTS: REVISION B





# THAAD FEATURES

---

- **Endo And Exo Intercepts**
- **Long Range Capability**
- **IR Seeker**
- **Hit-to-kill**
- **Deployable By C-130**
- **Engagement Operations (EO) And Force Operations (FO) Functions In Tactical Operations Center (TOC)**
- **Theater Missile Defense - Ground Based Radar Provides Surveillance / Fire Control For System**
- **Modular Design Allows Use Of Space Based Assets**



# THAAD ACQUISITION

---

- **Concept Definition**
  - **Contract Awards For Missile Design In August 1990**
    - Lockheed Missiles And Space Company
    - McDonnell Douglas Space Systems Company
    - SPARTA
  - **Redirected January 1991 To Design THAAD System (Missile, Radar, BM / C<sup>3</sup> ) Vice Missile Only**
  - **Redirected May 1991 To Design THAAD Missile, BM / C<sup>3</sup> And Integration With GFE X-Band TMD-GBR**
  - **Contracts End May 1992**
  
- **Demonstration And Validation**
  - **RFP Released In January 1992**
  - **Contract Award 4th Quarter FY 92**
  - **Two-fold Purpose**
    - **Prove Concept Ready To Proceed To MS II**
    - **Build Deployable Prototype System For Crisis Deployment If Necessary**



## INITIAL THAAD OBJECTIVE

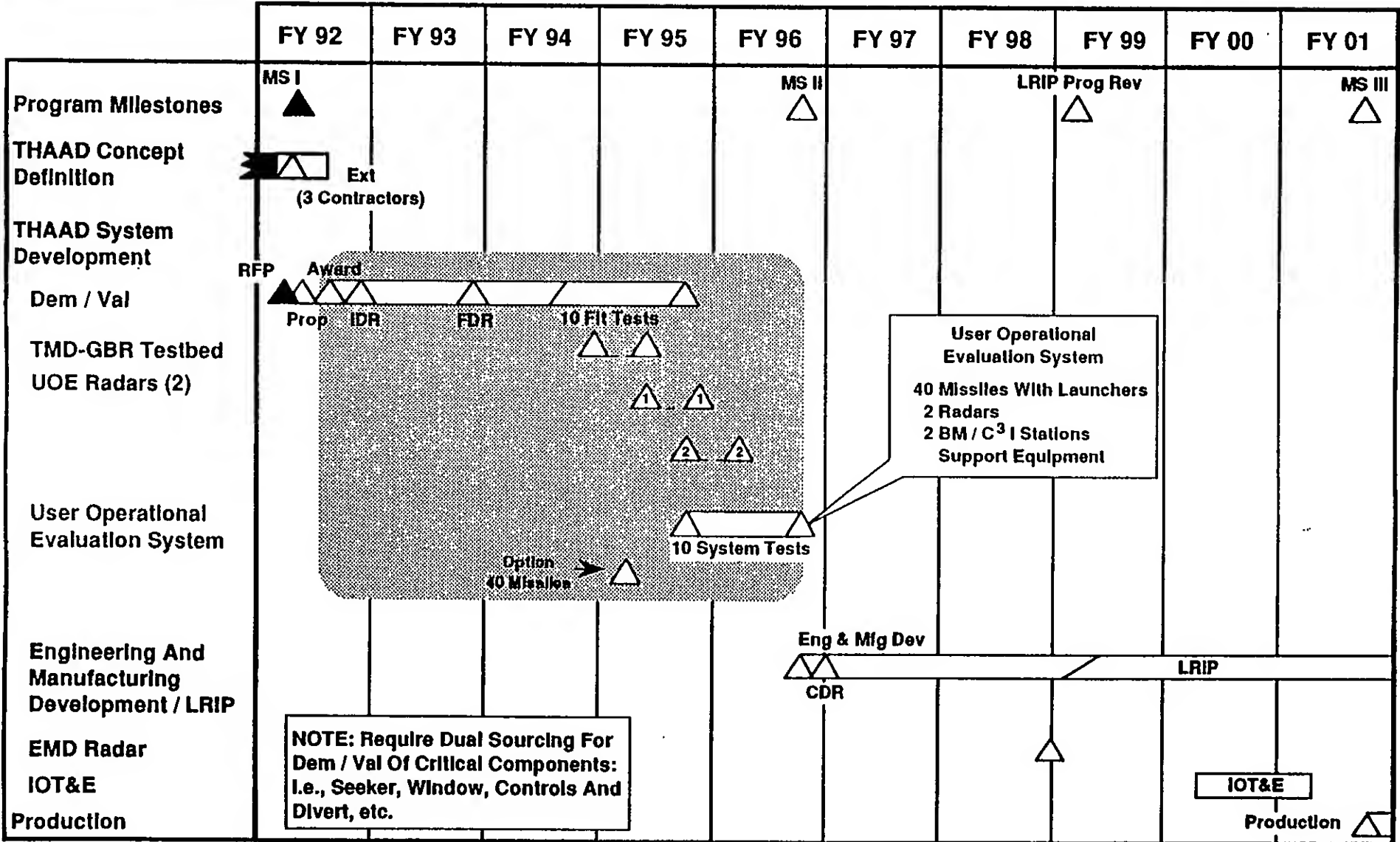
---

- **Build A Dem / Val "Prototype" THAAD Capability By 1996 For Test And Early User Assessment At WSMR**
  - **40 Missiles With Launchers**
  - **2 TMD-GBRs**
  - **2 THAAD TOCs**
- **With Special Support Provisions, This Capability Could Be Deployed In The Event Of A Crisis Situation**





# THAAD SYSTEM PROGRAM SCHEDULE





## AIRLIFT COMPARISON: PATRIOT vs THAAD

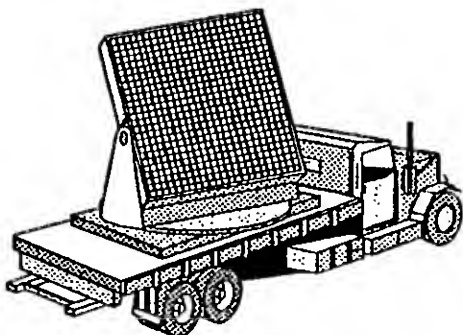
<b>Equivalent Coverage In SW Asia Scenario</b>	<b>Sorties</b>			
	<b>C-130</b>	<b>Or C-141</b>	<b>Or C-17</b>	<b>Or C-5</b>
<b>PATRIOT</b> <b>2 HQ Bn And 16 F / U</b> <b>(512 On-line Missiles,</b> <b>512 Reload Missiles)</b>	--	764	461	251
<b>THAAD 2000</b> <b>1 HQ Bn And 4 F / B</b> <b>(288 On-line Missiles,</b> <b>288 Reload Missiles)</b>	206	94	57	40

**Note: F / U = PATRIOT Fire Unit (8 Launchers)**  
**F / B = THAAD Firing Battery (9 Launchers)**



# THEATER MISSILE DEFENSE - GROUND BASED RADAR (TMD-GBR)

## TMD - GBR

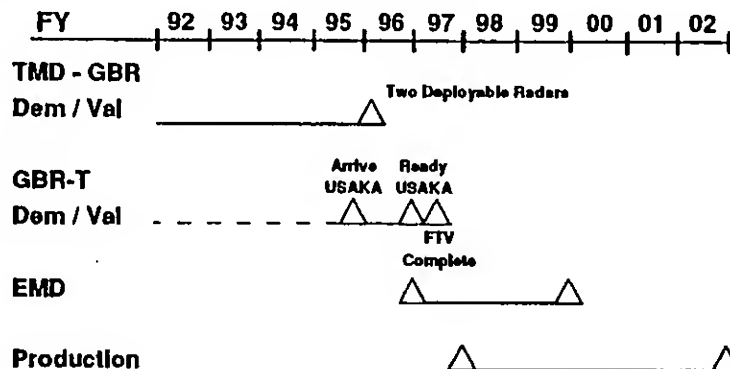


First Increment Of Codevelopment With GBR-T In The "Family Of Radars"

## Missions

- Theater Wide Area Defense Providing Horizon And Volume Search
- Acquire, Track, And Classify Targets From Multiple Objects
- Multiple Target / Interceptor Tracking
- Provide Fire Control To THAAD, Kill Assessment And Cueing To PATRIOT / ERINT Underlay
- Operate In ECM Environment
- Launch / Impact Point Prediction
- C-130 Transportable
- Provide BM / C<sup>3</sup> Support

## Schedule





# GBR PROCUREMENT

---

- **White Sands Range Radar (1994)**
- **Two Deployable TMD-GBRs (1995)**
- **GBR-T At Kwajalein (1995)**



# TOPICS

---

- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**
- **Technical Activities**
  - **System Acquisition**
  - **Architecture And Analyses**
    - **Pillars**
    - **Sensors**
    - **Weapons**
    - **Theaters**





# LAUNCH DETECTION STUDY FINDINGS / ACTIONS

---

- **Launch Detection Is Essential For Effective TMD**
- **Current System Is Only Viable Capability For Now Through Mid To Late 1990s**  
*Action: Promulgate Tactical / Theater Mission Support Requirements For Launch Detection*
- **Tactical Mission Support Requirements Fundamentally Different From Strategic**  
*Action: Implement Dedicated Tactical Processor / Display System*
- **Revisit Rate Does Not Support Quality Burnout Condition Determination**  
*Action: Demonstrate Augmentation With High Revisit Rate Sensor*
- **Timely Delivery Of Launch Detection Data To Theater Is Mandatory**  
*Action: Promulgate Communication Connectivity, Protocols, And Formats For TMD*
- **External Cueing Of Radar / TMD Components Is Very Beneficial To TMD Performance**  
*Action: Develop / Implement Interfaces For Cueing Data Inputs At TMD Components*



# TOPICS

---

- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**
- **Technical Activities**
  - **System Acquisition**
  - **Architecture And Analyses**
    - **Pillars**
    - **Sensors**
    - **Weapons**
    - **Theaters**





# COUNTERFORCE

---

- **Objective**
  - **Destroy Missiles Before Launch:  
Fueling / Arming / Transport, etc.**
  
- **Priority**
  - **Very High**
  
- **Critical Issues**
  - **Launcher Location Uncertainty**
  - **Decoys**
  - **Rapid Weapon Reaction**
  
- **Elements**
  - **Sensors**
  - **Integration / Coordination**
  - **Communications**
  - **Weapons**





# COUNTERFORCE CHALLENGES

---

- **Wide Area Search Capability**
- **All Weather, Day / Night Coverage**
- **Foliage Penetration**
- **Denied Surveillance Areas**
- **Very Timely Coverage**
- **Robust Detection And Identification Algorithms For Fixed And Moving Targets**
- **Decoys, Camouflage, Masking**
- **C<sup>2</sup> And Fusion Network For Rapid Dissemination Of Data**
- **Quick Response Weapon System Fly Out And Kill**



## C<sup>3</sup> I FUNCTIONS

---

- **Integration Of Information (Fusion)**
  - **Intelligence**
  - **Launch Detection**
  - **Remote Unattended Sensors**
  - **Communication Links**
  - **Satellites / Airborne Sensors**
  
- **Integration And Control Of Operations**
  - **Air Defense And Cruise Missile Defense**
  - **Navy Operations**
  - **Active TMD Defense**
  - **Counterforce**



## **TMD BM / C<sup>3</sup> PROGRAM ASSUMPTIONS**

---

- **Theater Missile Defense (TMD) Is An Extension Of Tactical Air Defense**
- **TMD BM / C<sup>3</sup> Must Integrate With And Capitalize On Existing Heavy Service Investment In Air Defense BM / C<sup>3</sup>**
- **TMD BM / C<sup>3</sup> Should Be Phased In With Air Defense BM / C<sup>3</sup> Upgrades Planned By Services**



## PASSIVE DEFENSE

---

- **Objective:** Improve Asset Survivability
- **Measures:** Concealment, Hardening, Dispersion, Mobility, Deception
- **Note:** Iraq Used Such Measures To Protect Scud Launchers
- **Possible Efforts:**
  - Laser Sensing Of Chemical Dispersion After Warhead Destruction
  - Study PATRIOT And THAAD Protection From Attack
  - Study Common Techniques For Self-protection



# AIR FORCE PROGRAM

---

- **Active Defense**
  - **DSP Upgrade**
  - **Surveillance Testing**
  - **Architecture And Analysis**
- **Counterforce**
  - **Studies Of Sensors And Weapons**
- **C<sup>3</sup>I**
  - **Included In Active Defense And Counterforce**



## NAVY TMD

---

- **Near Term**
  - **Anti-air Warfare (AAW) Underlay Improvements Consisting Of AEGIS / SPY-1 Modifications And Improvements To SM-2 Block IV To Improve Performance In The TBMD Role**
- **Far Term**
  - **Long-range Endo- And Exo-intercept Capability Using THAAD Or Navy's Unique Weapon Coupled With AEGIS / SPY-1 Upgrades**



# MARINE PROGRAM

---

- **To Provide Limited Area, Highly Mobile TBM Defense For Marine Corps Operations**
  - **Upgrade OF TPS-59 To Provide Enhanced TBM Surveillance And Tracking Capability And Make Data Available On The Net**
  - **Upgrade Of HAWK Launcher To Interface With Digital Missile**
  - **Provide Guidance And Warhead Enhancements To HAWK Missile**
  - **Modify High Power Illuminating Radar System (HIPIRS) To Accept TPS-59 Data For Acquisition**
  - **R & D Of Air Defense Command Post To Act As A Node For Tactical Nets; JTIDS, TADIL-A, TADIL-B**



## MIDCOURSE SENSING STUDY ACTIONS

---

- **Initiate Development Of UAV Platform With IR And LADAR Sensors To Provide:**
  - Hedge Against Radar Jammers And Pen aids
  - Substitute For Ground Radars In Rapid Deployment Or Extension Of TMD Defense Coverage
  
- **Support Mid-90s Deployment Of BE Block I In Order To Provide Large, Robust Defense Footprints For Theater Area Defense. BE Design Must Include Adequate Communications To Support Theater Defense**
  
- **Maintain Modularity In The GBR-TMD Development Program In Order To Have One Or Two Module (1/8 Or 1/4 Size) Radars To Support Remote Interceptor Sites For**
  - Shoot-look-shoot Expansion
  - Interceptor Track And Communications
  - Rapid Deployment Or Expansion Of TMD To Theaters
  - Protection Of Amphibious Landing Area





## BRILLIANT EYES CONTRIBUTION TO TMD

---

- **Possible Design**
  - **18-36 SWIR / MWIR / LWIR Satellites**
  - **Orbit: Medium Altitude, Single Inclination**
  
- **Capabilities**
  - **Theater Wide Launch Detection**
  - **Cueing And Possible Pre-radar Commit For Active Defense**
  - **Global Capablitiy To Support**
    - **Rapid Deployment Forces**
    - **Deployed Naval ATBM Systems**
    - **Data Gathering**



# BRILLIANT PEBBLES CONTRIBUTION TO TMD

---

- **Possible Design**
  - 500 SWIR / MWIR / H-T-K Satellites
  - Orbits: Low Altitude; Multiple Inclinations
  
- **Capabilities**
  - Global Launch Detection
  - Global Weapons Capability Against TBMs Of Over 500 km Range
  - Global Surveillance Support Similar To Brilliant Eyes



# CORPS SAM

---

- **Protection Of Mobile Forces**
- **Capable Against Aircraft, Cruise Missiles And TBMs**
- **Replacement For HAWK**
  - **Airlift Deployability**
  - **Maneuverability**
  - **Reload**
  - **Firepower**
- **May Involve Allies**
- **Concept Definition Studies In FY 92 And FY 93, MS I  
In FY 93; IOC Beyond 2000**



## TMD ADVANCED TECHNOLOGY REVIEW FINDINGS / ACTIONS

---

- **Airborne Laser Offers Greatest Potential For Boost Phase Intercept, But**
  - Propagation And Lethality Are Major Uncertainties
  - Cost, Packaging, Major System Trades Must Be Done

*Action: Emphasize Propagation and Lethality Measurements And Modeling; Support Concept Definition Studies*
- **Hypervelocity Gun And Projectiles (HVG&P) - Good Candidate For "Cheap Shot" Cluster Kill And Terminal Defense Of High Value Targets**

*Action: Focus HVG&P On Cluster Kill And Deployability*
- **Airborne LADAR Can Provide High Quality Tracking To Support Extended Surveillance, Discrimination And Kill Assessment, And Cluster Kill / Fire Control For HVG & P**

*Action: Develop Operational Concept For Implementing Airborne LADAR, Including Identification Of Airborne Platform And Flight Paths, Message Flow And Communication Links, And Command And Control Procedures*



# THEATER DEFENSE - ARCHITECTURE STUDIES

---

## BILATERAL

United Kingdom  
Israel

## TMDAS

CoSyDe  
SNIA  
MBB  
Hughes  
LTV

## WESTPAC

LTV  
MHI

## PRODUCTS

- Candidate Architectures
- Mission Requirements
- Critical Technology Issues
- Effectiveness Analysis
- Life Cycle Cost Analysis
- Basing Analysis
- System Balancing
- Detailed System Requirements
- Interface Requirements
- BM / C<sup>3</sup> Requirements
- Technology Plan
- Development Plan
- Operational Concepts



# UK ARCHITECTURE STUDY

## Objectives

- Develop A BMD System To Protect Western Europe
- Identify Threat Excursions And Evaluate Architecture Sensitivities
- Examine Synergism Between European BMD / TMD Architectures And U. S. Strategic Defense System
- Coordinate U.S. / UK Joint Programs
- Refocus On GPALS Environment

## Task Description

- Develop Representative Threats And Scenarios
- Provide Simulation And Modeling Capability
- Develop And Evaluate Candidate Architectures
- Assess Interoperability Of Defense Systems
- Identify Means Of Enhancing Interoperability
- Assess Architectural Relevance Of U.S. / UK Joint Programs

## Issues

- Midcourse And Endo Discrimination
- Robustness Of Endo Defenses
- Interceptor Configurations And Tier Balance
- Cost-effectiveness

## Contractor Team

- Contract Managed By USASDC
- UK MOD / SDIPO
  - Siemens Plessey Defence Systems (Prime)
  - British Aerospace Corp.
  - Hunting Engineering Ltd.
  - PA Defence Systems
  - Data Sciences



## WESTPAC ARCHITECTURE STUDY

---

- **Objective**
  - To Provide USCINCPAC And WESTPAC Commanders With Vehicle To Study TMD
  - To Provide GOJ Insight To TMD Needs For JDF; Foundation For Testbed
  - To Provide SDIO / TD Insight Into WESTPAC Special Requirements
  
- **Two Teams**
  - Japanese Perspective: Mitsubishi Heavy Industries And SAIC
  - U.S. Perspective: LTV And Kawasaki Heavy Industries
  
- **Three-phase Program**
  - FY 89: Defense Of Japan Against Conventional Missile Threat
  - FY 90: Defense Of Japan Against Non-conventional Missile Threat
  - FY 91: Defense Of 1000 n.m. Radius Around Japan And Initial Excursions Into Korea And Other Asian Partners
  
- **No Direct Government Of Japan Involvement**



# ISRAELI ARCHITECTURE STUDY

---

- **US-GOI Contract, Initiated In 1986 With WALES, Inc. Assisting GOI**
- **Looks At Middle East Region Focusing On Chemical Threat And Israeli Technology**
- **Includes System Engineering And Integration With Other US-GOI Joint Efforts**





# TOPICS

---

- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**
- **Technical Activities**
  - **System Acquisition**
  - **Architecture And Analyses**
  - **Experimental Support**
    - **Test Beds**
    - **Lethality**
    - **CM / Discrimination**
    - **Experiments**





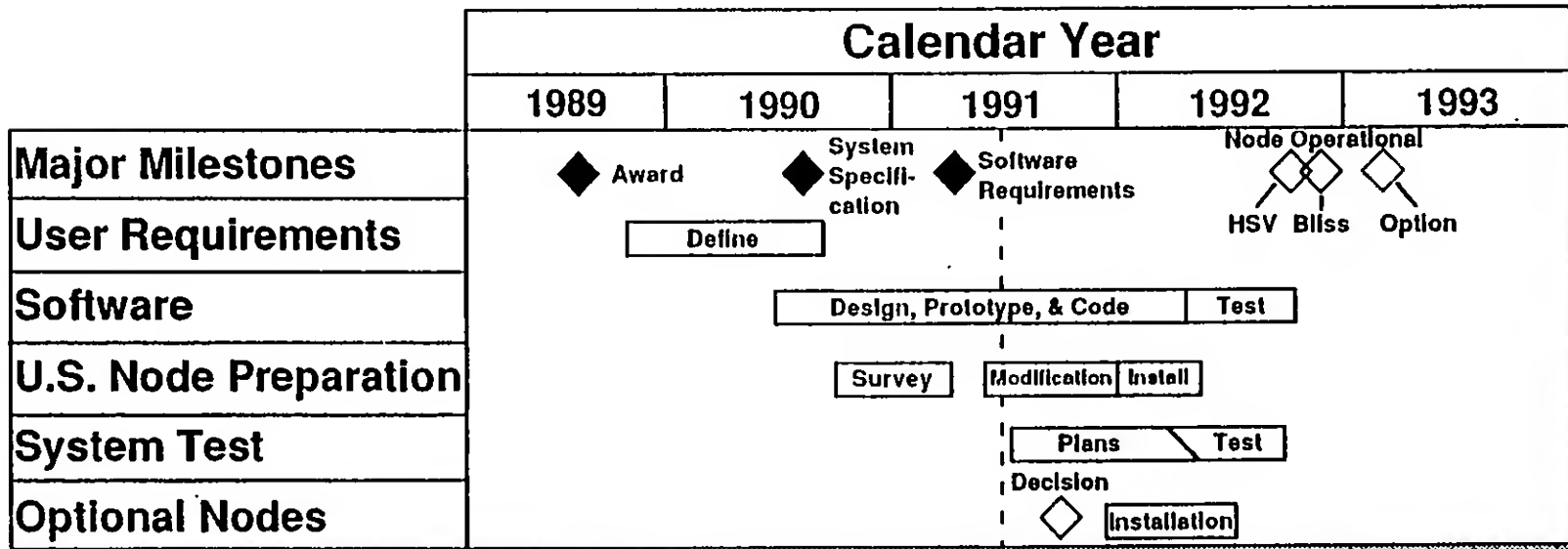
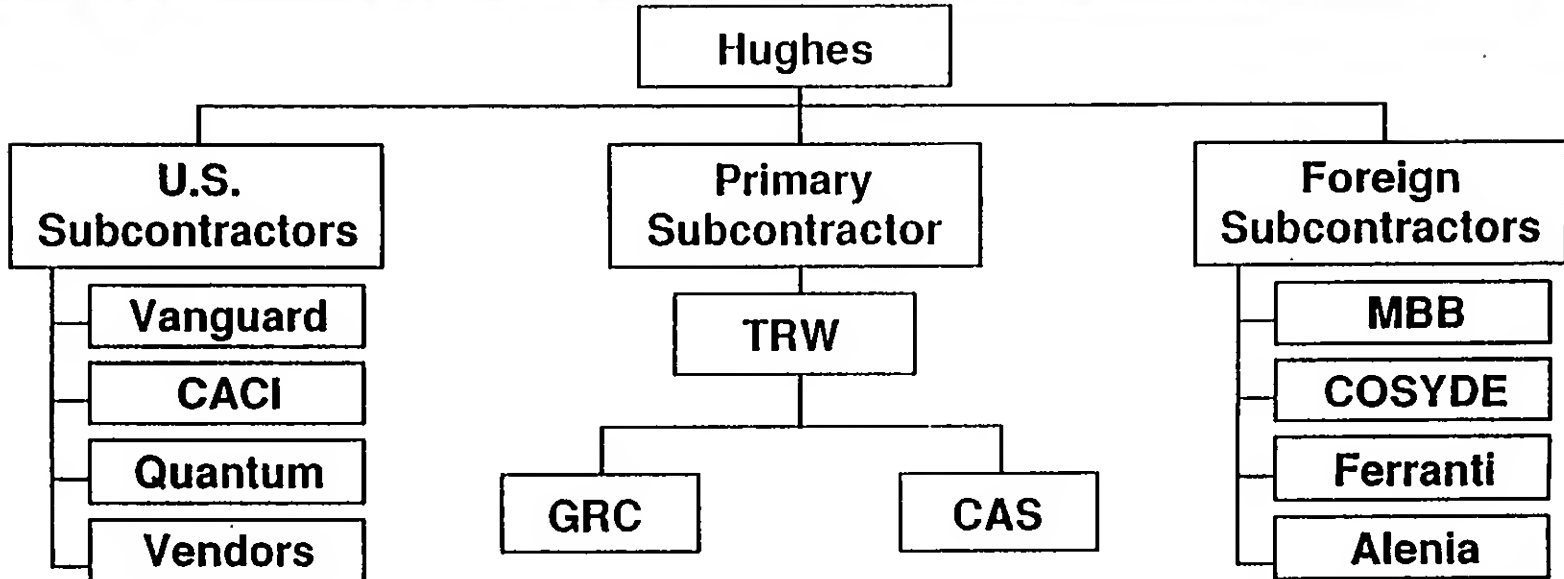
# THEATER TEST BEDS

---

- **Objective**
  - Provide Common Analysis Tools To Support Resolution Of Extended Air Defense (EAD) Issues Related To The Following Areas
    - Theater Level System Requirements, Architectures, Force Structures, And Operational Concepts
    - Doctrine And Battle Planning
    - Mix And Interaction Of Various Weapon Systems
    - System Integration, Interoperability And Interface
    - Technology Applications To Systems And Concepts
    - Wargaming, Live Exercise Preparation And Evaluation, And Training
  
- **Activities**
  - EADSIM
  - EADTB
  - EADTB - UK Node
  - Israeli Test Bed



# EADTB DEVELOPMENT





# UK TEST BED

## Objectives

- Extend UK Air Defense Test Bed To Evaluate TMD Issues
- Create EADTB Node Capable Of Stand-alone Operations And Networking With Other Nodes
- Develop Common And UK-unique High Fidelity Models

## Program Description

- Joint Program With Shared Costs (US 52%, UK 48%) SEP 88 - SEP 92
- Develop SIMBOX2/DISCON2 In Ada
- Enhance SIMBOX2/DISCON2 For TMD
- Create Libraries Of Models To Satisfy Initial Terminal Tier Experiment
- Design, Implement, Execute, And Analyze Experiment

## Status

- CONVEX C220 Installed - Operational
- SIMBOX 2 Framework Operational
- DISCON 2 Prototype Operational
- Terminal Tier Experiment Defined
  - Software In Development

## Contractor Team

- LOA Between USASDC And UK Defense Research Agency Electronics Division, Effort Contracted To
  - Data Sciences
  - Hunting Engineering



# ISRAELI TEST BED

## *Objectives*

- Provide Israeli And U.S. Capability For Evaluating TMD Architecture Concepts In The Middle East
- Support Evaluation Of Key Technologies To TMD
- Provide Resolution of Critical Man-in-The-Loop Issues

## *Task Description*

- Cooperative Venture Of U.S. And Israeli Governments
  - Develop Stand-alone Test Bed Unique To Israeli Environment
  - Evaluate Middle East Missile Defense Designs And BM / C3 Against Defined Threats
  - Include Man-in-the-loop And Hardware-in-the-loop Mechanisms
- Funding: U.S., 72%; GOI 28%
- Experiments Identified For Joint And Unilateral Participation

## *Status*

- Tadiran Contract Awarded June 1989
- Detailed Design Satisfactorily Reviewed
- Coding And Unit Testing Being Completed
- Integration Efforts initiated
- Computer Hardware Selected
- Facility Location Selected (Tadiran)

## *Contractor Team*

- USASDC (Executing Agent)
- Tadiran (Prime)
  - ELTA
  - Contahal
  - Rafael (GOI Armament Authority)
  - Advanced Technology, Ltd (ATL)



## LETHALITY SUMMARY

---

- **Hit-to-Kill, From A Lethality Perspective, Is The Most Promising Concept For Negation Of Stressing Threats**
- **Hit-to-Kill Can Be Achieved**



# LETHALITY

---

- **Priority Item**
- **Three-pronged Risk Reduction Approach**
  - **Detailed Simulations**
  - **Early Sub-scale And Full-scale Ground Tests (FY 91-93)**
  - **Flight Tests With Broad Spectrum Of Threat Warheads (FY 92-94)**
- **Funding**
  - **FY 90            \$2.7M**
  - **FY 91            \$10.0M**
  - **FY 92            \$30.0M**
  - **FY 93            \$30.0M**



# KEY LETHALITY ISSUES

---

- **Hit-to-Kill**
  - **Guidance Accuracy**
    - Response Time
    - Seeker Noise / Bore Sight Errors
    - Active Seeker Cooling Effects
  
  - **Target Uncertainties**
    - Warhead Type / Design
    - Tumbling / Breakup
    - Countermeasures
  
  - **Aimpoint Selection**
    - Seeker Resolution
    - Aimpoint Algorithms
  
- **Intercept Altitude**
  - Endo Hit-to-Kill
  
- **Warhead Lethality**
  - Canister Submunitions





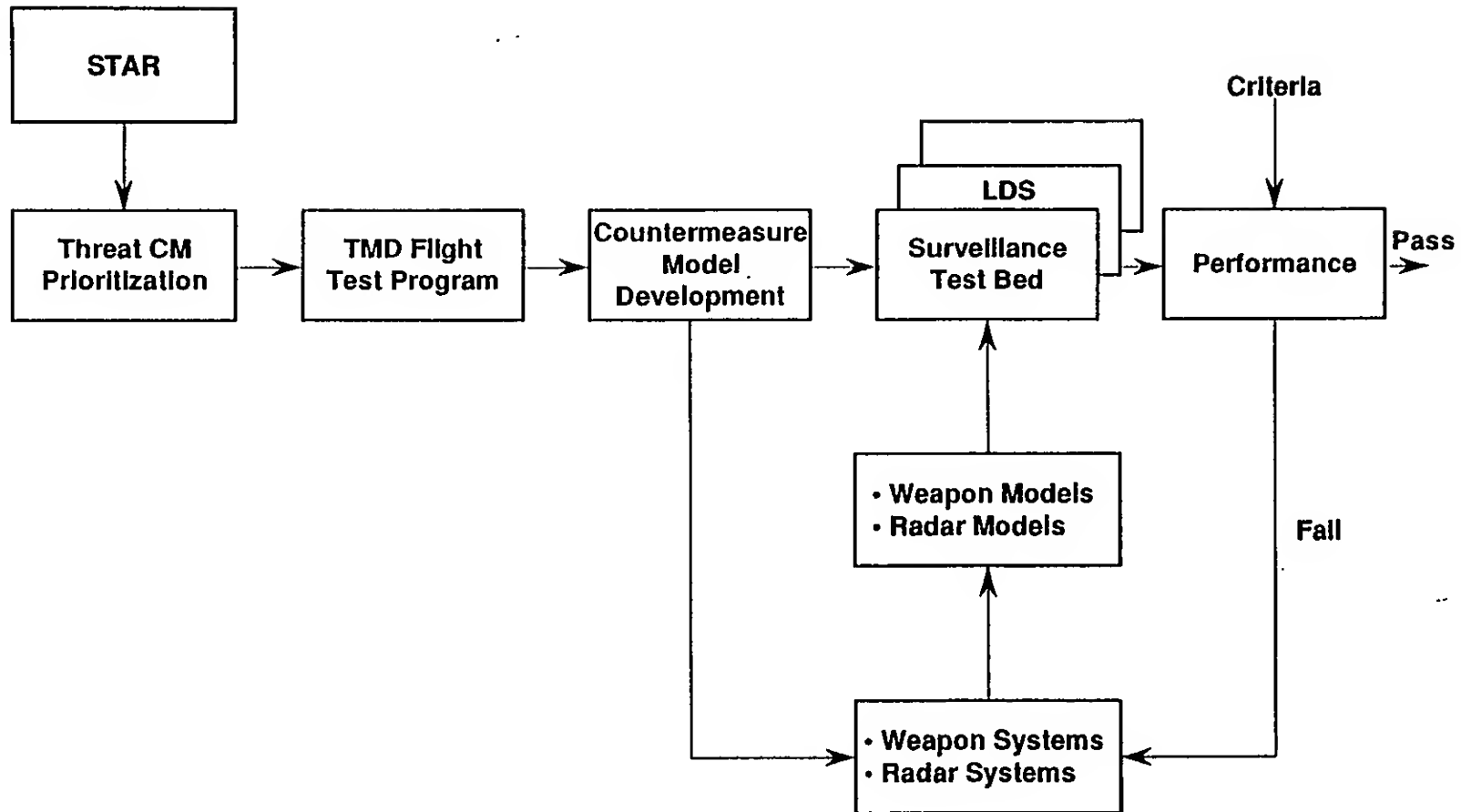
## HISTORY OF HIT-TO-KILL

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- **Homing Overlay Experiment (HOE)**
  - Demonstrated  $\approx 0.5$  m Miss (Exo)
  - $\approx 5$  km / sec
- **Miniature Homing Vehicle (MHV) (U.S. Anti Satellite Weapon (ASAT))**
  - Demonstrated  $\leq 1$  m Miss (Exo)
  - $\approx 5$  km / sec
- **Flexible Lightweight Agile Guided Experiment (FLAGE)**
  - Demonstrated  $\approx 0.3$  m Miss (Endo)
  - $\approx 3$  km / sec
- **Exoatmospheric Reentry Vehicle Intercept System (ERIS)**
  - Demonstrated  $\approx 0.3$  m Miss (Exo)
  - $\sim 5$  km / sec



# DISCRIMINATION FLIGHT TEST PROGRAM





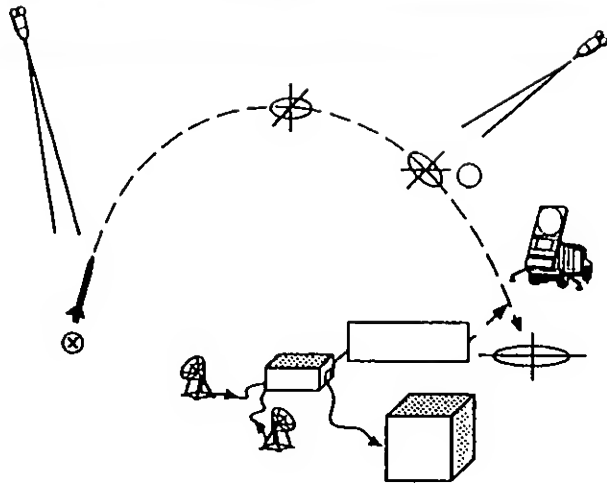
# END-TO-END KILL ASSESSMENT STUDY

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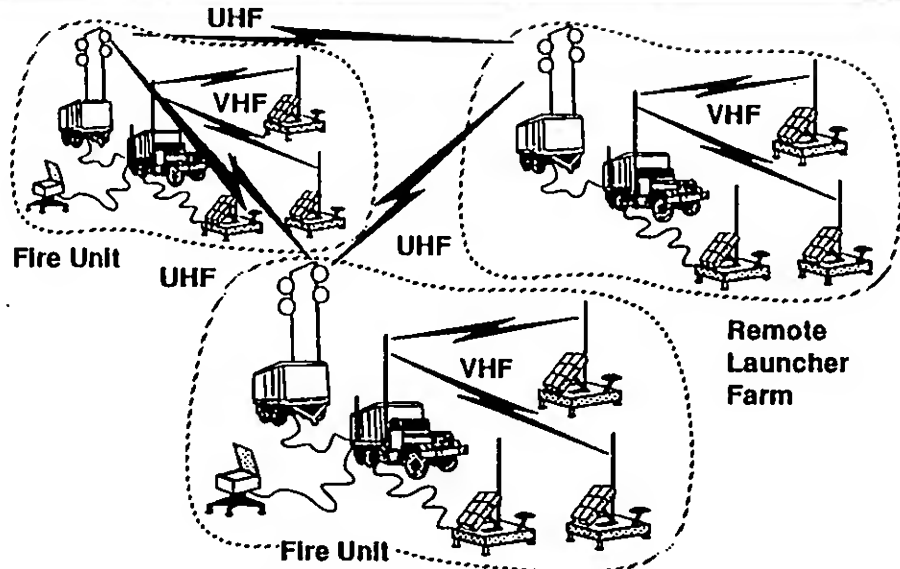
- Objective:**
  - Review And Analyze End-to-end Effectiveness Of TMD Weapons Systems, Linking Engagement And Lethality Models And Experimental Data
  
- Organization:**
  - SDIO Organized, POET Led, Service Participation
  
- Schedule:**
  - Kick-off – January 1992
  - Preliminary Recommendation – July 1992
  - Final Report – October 1992
  
- Products:**
  - Assessment Of Current Knowledge Of TMD Weapon System Effectiveness
  
  - Recommendation Of Models, Algorithm And Methodologies Which Should Be Used In Effectiveness Analysis
  
  - Recommendations For Associated FY 93 TMD Programs And Activities



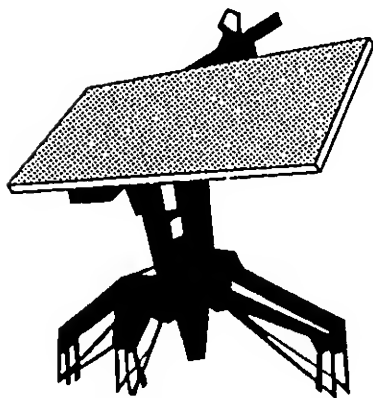
# EXPERIMENTS



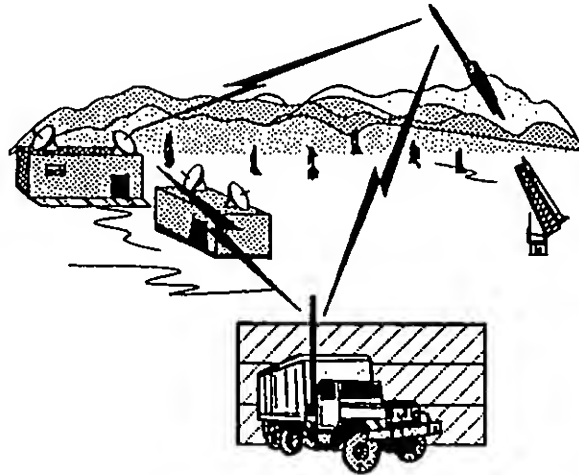
**Aerojet Tactical Surveillance Demo**



**Raytheon Remote Launch Demo**



**Westinghouse Advanced Expert Missile Tracker (EMT) Demo**



**IBM Passive Sensor System**



**Plessey Mesar Trials With Adaptive Nulling Demo**



# INVITE, SHOW AND TEST (IST) BROAD AREA ANNOUNCEMENT (BAA)

---

82a

- **Objective**
  - **Follow-on To Current Experiments Program**
  - **Test And Evaluate New Concepts / Systems / Equipment**
    - **Full JMNS Theater Missile Threat**
    - **All Four Pillars**
  
- **Status (1 MAR 92)**
  - **\$7.2 M For FY 92**
  - **49 Proposals Received Covering All Categories**
  - **14 Proposals Undergoing Final Review**
  - **Final Selection By 1 APR 92**



# THEATER CAPABILITY EXPERIMENTS

---

## *Purpose*

- Work With The CINCs And Services To Explore Thier Unique TMD Problems And Interfaces
- Conduct Experiments To Validate Problems And Solutions And Enhance Readiness

## *Scope*

- All Four Pillars Of TMD
- Inclusion / Integration Of Warning & Intelligence

## *Schedule Information*

<u>Organization</u>	<u>Timeframe</u>	<u>Event</u>
• CINCEUR	FY 89	Torpid Sunset
• CINCEUR	FY 90, 91	Torpid Shadow I & II
• CINCEUR	FY 92	Questor Grail
• CINCPAC	FY 93	TBD
• CINCCENT	FY 94	TBD



# TOPICS

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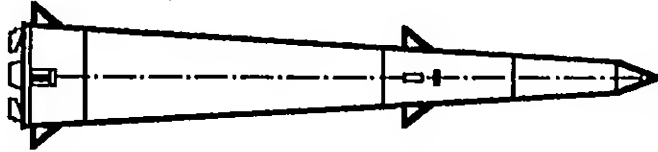
- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**
- **Technical Activities**
  - **System Acquisition**
  - **Architecture And Analyses**
  - **Experimental Support**
  - **Special Projects**





# ARROW

## Arrow Missile Concept



## Objective

- **Cooperative Program With Israel To Demonstrate Arrow's Capability To Intercept A Tactical Ballistic Missile**
- **Three-Year Firm-Fixed-Price Contract Signed With Israeli Aircraft Industries (IAI) In August 1988**
- **Four Flight Tests**
  - **Two Interceptor Flight Tests (AUG 90, MAR 91)**
  - **Two Propulsion And Control Tests (OCT 91)**





# ARROW CONTINUATION EXPERIMENT (ACES)

---

- **Follow-on To Arrow Development**
- **MOA Signed June 1991**
- **Contract With IAI**
- **Missile And Launcher Only**
- **11 Flights Through 1995**
- **Changes**
  - **Booster**
  - **Warhead**
- **Provides Alternative Approaches / Insurance To THAAD**



# TOPICS

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- **Background**
- **Requirements And Threat**
- **Program Organization And Scope**
- **Technical Activities**
  - **System Acquisition**
  - **Architecture And Analyses**
  - **Experimental Support**
  - **Special Projects**



- **Programmatics**



# TMD DOCUMENTATION

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- Theater Missile Defense Report To Congress, 30 MAR 91
- TMD Master Program Plan (Based On Service Program Plans)
- TMD Mission Requirements Document (Based On MNS, ORD, etc.)
- TMD System Description
- Active Defense Requirements Document
- C<sup>3</sup>I Requirements Document
- SDIO Report To Congress, June 1992



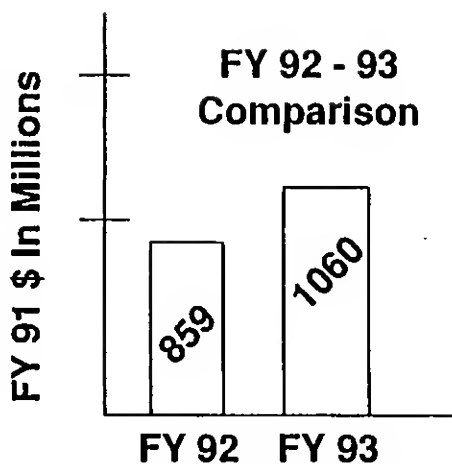
## TMD BUDGET IN FY 92

---

<u>Area</u>	<u>\$M</u>
• System Acquisition Program	493
- PATRIOT	170
- ERINT	171
- THAAD	108
- TMD-GBR	44
• Architecture And Analyses	180
• Experimental Support	125
• Special Projects	60
<b>Total</b>	<b>\$858M</b>



# TMD BUDGET FY 93



**Adjustments Required**

- Navy TMD
- AF TMD (BMC<sup>3</sup>)
- Others

<b>TMD MDAPS</b>		<b>(TY \$M)</b>
CORPS SAM		25
PATRIOT		186
UTTMDS		381
THAAD	258	
TMD-GBR	123	
<b>Subtotal</b>		<u>592</u>
<b>Other TMD</b>		
ERINT		135
Navy		19
Air Force		14
ACES		58
TMD Integration		11
Advanced Sensors		72
TMD Studies		38
TD Countermeasures		11
C <sup>4</sup> I		19
Theater Test Bed		37
Other		54
<b>Subtotal</b>		<u>468</u>
<b>Total</b>		<u>1060</u>



# TECHNICAL PROBLEMS AND CHALLENGES

---

- **Lethality**
- **Software**
- **Boost Phase Kill**
- **Countermeasures**



# MAJOR INDUSTRY OPPORTUNITIES

---

- **In Process**
  - **THAAD**
  - **TMD - GBR**
  - **IST BAA**
  
- **Upcoming**
  - **CORPS SAM**
  - **Navy TMD**
  - **Air Force Program**



## SUMMARY

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- **High Administration And Congressional Interest In Theater Missile Defense (TMD)**
- **TMD Is Part Of GPALS, But Must Have An Earlier Stand Alone Capability**
- **An Aggressive TMD Program With Multiservice And International Participation Has Been Initiated**
- **THAAD / TMD-GBR And PATRIOT PAC - 3 Are The Centerpieces Of The Near Term Active Defense Segment Of TMD; Improved Processing And Distribution Of Launch Detection Data Is Required**
- **Navy, Air Force, And Marine Corps Programs Are Underway Or Are Being Formulated**
- **The TMD Program Also Features Architecture, Analyses, And Experimental Support Activities**



# STRATEGIC DEFENSE INITIATIVE

## Advance Planning Brief For Industry National Test Bed



2 MAR 92

CDR Ed Lenio, USN  
Deputy Director, National Test Bed  
Strategic Defense Initiative Organization



# OUTLINE



- **NTB Mission**
- **Program Summary**
- **Industry Contributions**



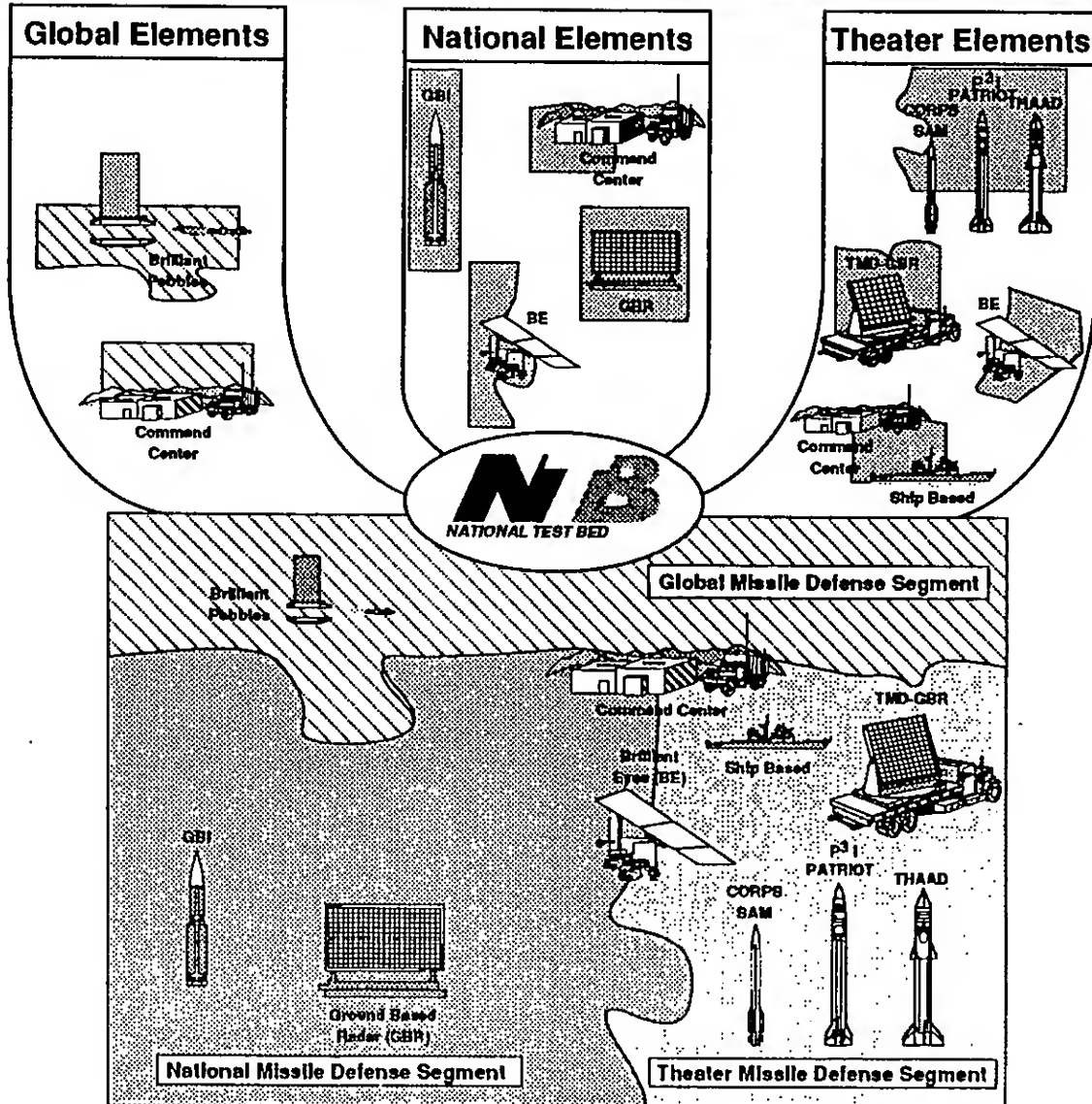
# NTB MISSION



Support Design And Development Of Missile Defense Elements

Support Testing And Element Integration Into Segments

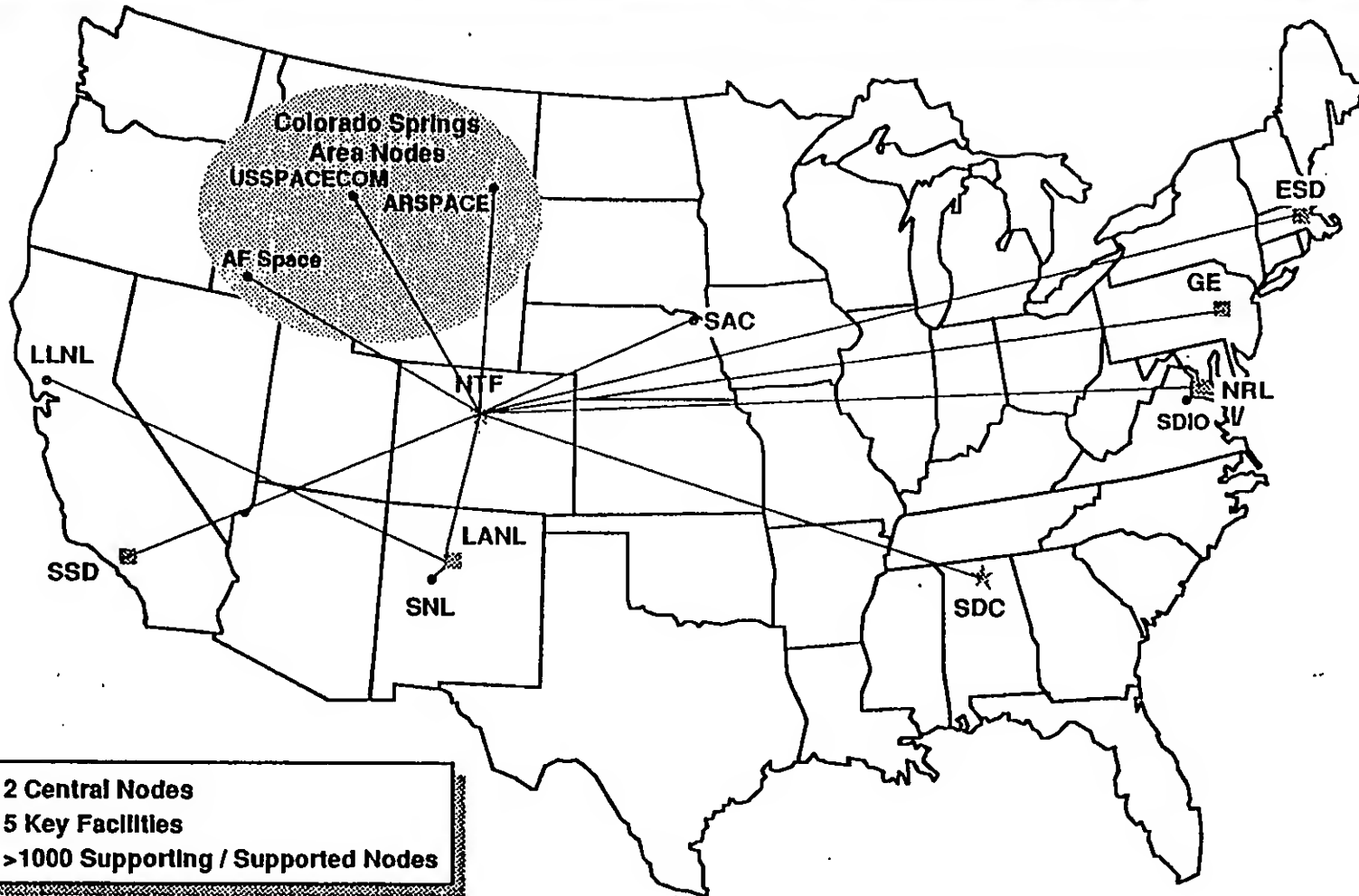
Support Testing And Segment Integration Into GPALS



Global Protection Against Limited Strikes



# NTB NETWORK





# NTB PROGRAMS SIMULATIONS / EMULATIONS



## Background

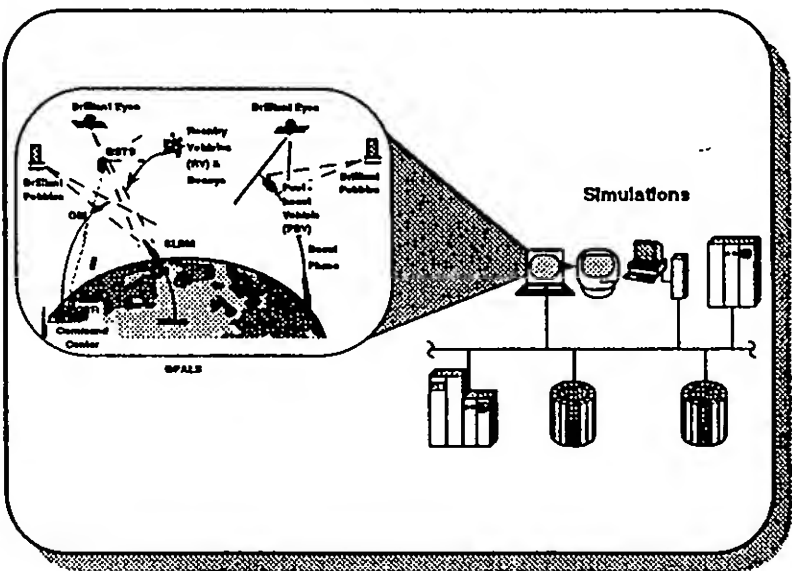
- BP Simulator
- KEW Digital Emulation Center (KDEC)
- End-to-end System Level Simulators (L1SS, L2SS)
- Analytical Tool Box Of Verified, Validated, And Accredited (VV&A) Simulations
- Support For Element Simulations

## Plans

- VV&A Program
- Surveillance Test Bed Integration
- EADTB Interface / Hosting
- GBR Test Facility Integration
- L2SS GPALS Element Integration

## Accomplishments

- L1B1 Tested Successfully
- L2B1 Requirements Defined
- KDEC Installed In SIMCEN





# NTB PROGRAMS - BM / C<sup>3</sup> SIMULATION, EMULATION, AND PROTOTYPING



## Background

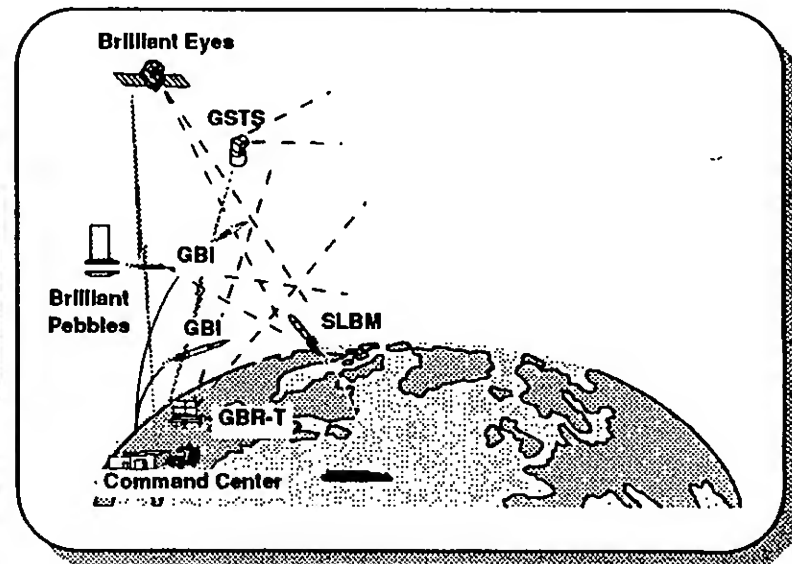
- Concept Of Operations Exercises (GPALS, And Initial Deployment Systems)
- BM / C<sup>3</sup> Development And Testing
- C<sup>2</sup>E Prototype
- Multi-agency BM / C<sup>3</sup> Experiments

## Plans

- Two Major CONEXs
- C<sup>2</sup>E Prototype
- Continued BM / C<sup>3</sup> Experiments
- Continued CONOPS Refinement
- EV Models Scripted In ARGUS

## Accomplishments

- Two Major C<sup>2</sup> Games Conducted
- CONOPS Refinement
- BM / C<sup>2</sup> Experiments
- EV LPS Scenario Demonstration
- ARC Node Involvement In CONEX 91-C





# NTB PROGRAMS - INTEGRATED SYSTEM TEST CAPABILITY (ISTC)



## Background

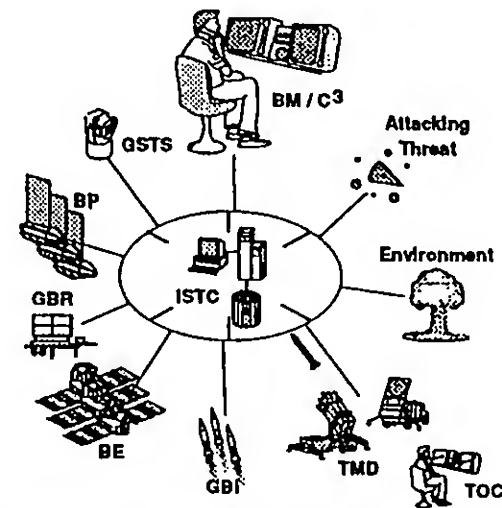
- Support Milestone And Fielding Decisions
- Hardware / Software-In-the-loop
- Individual And Multiple Element Testing
- Distributed Defense Concepts Testing

## Plans

- 2 Node Proof Of Concept
- ARC / NTF ISTC Integration
- Support GPALS DT / OT Process
- Maximum Use To Support Segment Integration / Testing

## Accomplishments

- ISTC Requirements In Final Draft
- ISTC Preliminary Design Completed
- Limited Test Cases Executed Successfully
- ISTC Prototype Installed At NTF And ARC





# NTB PROGRAMS - CENTER FOR RESEARCH SUPPORT (CERES)



## *Background*

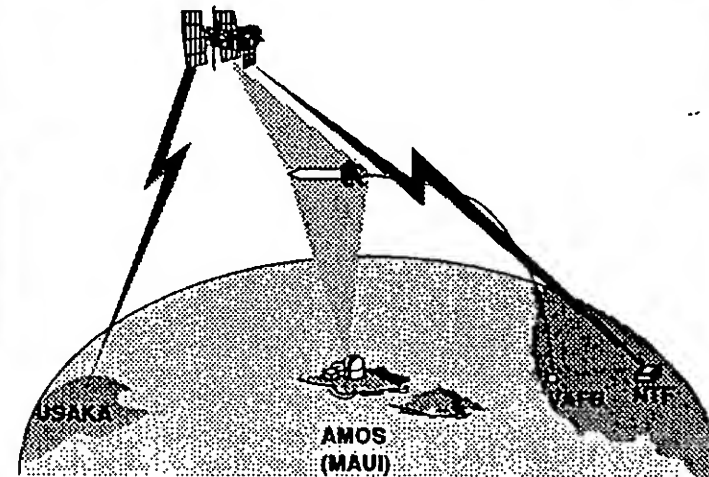
- Provides PMs With Mission And Science Operations Centers
- Links PMs With Test Ranges And Data Repositories

## *Plans*

- CSTC Communications
- Telemetry Processing, Phase I
- Facility Configuration

## *Accomplishments*

- CERES I, Phase I Facility Complete
- BP Support Facility Design Initiated







# NTB NETWORK



## Background

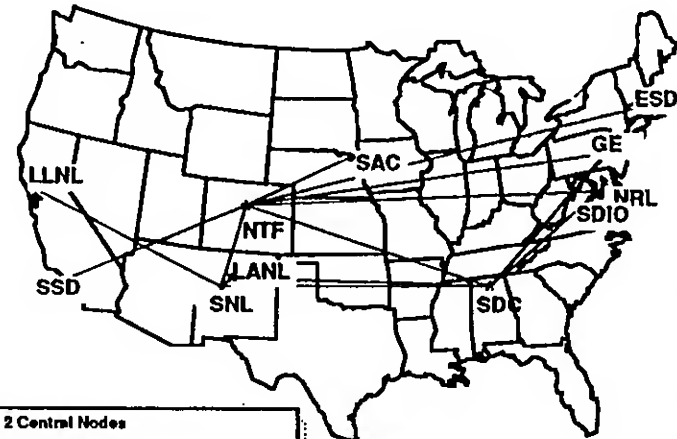
- **Widely Distributed Network Links Through Primary To Support Nodes, Testbeds, And Centers**
- **Access To Super- And Parallel-Computers**

## Plans

- **Four New User Sites**
- **MLS Migration Strategy**
- **Integration Of Network Control Center**
- **Multimedia Capabilities**
- **Test Range Connectivity**
- **High Performance Network Enhancements**

## Accomplishments

- **SATCOM To Terrestrial Conversion**
- **Five New User Nodes**
- **Open System Architecture Implementation**
- **40% User Increase**
- **Secure Network Architecture Study Completed**



★ 2 Central Nodes  
■ 5 Key Facilities  
• >1000 Supporting / Supported Nodes



## WHERE INDUSTRY CAN HELP



### *Simulations / Testing*

- Real Time High Fidelity Simulations
- Multi-use Adaptability
- Multi-level Fidelity
- Non-intrusive Testing

### *Software*

- Parallelized Systems
- Testing Tools / Methodologies
- Visualization
- Hyper Matrix Tools
- Ada CAD / CAM
- Resource Accounting / Management

### *Networks*

- Heterogeneous Interfaces
- Low Latency
- High Data Transfer Rates
- MLS Capabilities
- Multimedia Capabilities

### *Hardware*

- Electronic Mass Data Storage
- High End Graphic Work Station Technology
- Security
- High Performance Gate Arrays

## SIMULATIONS/TESTING

### REAL TIME HIGH FIDELITY SIMULATIONS

Real time high fidelity simulations are essential to the conduct of human in control experiments where human responses are critical. Large scale high fidelity simulations requiring controllable, discrete events necessitates real time computer operating systems to insure consistent repeatable experiments. Where specific execution times are critical to the issues at hand, a real time operating system is needed. Many times in troubleshooting or development of a system, operation in WARP time is required. This is where you process data in faster than real time to facilitate the concentrated analysis on a specific area of the simulation or to present a quick look at the entire simulation.

### MULTI-USE ADAPTABILITY

Simulations are needed that are readily adaptable to varying scenarios. This is needed to provide greater efficiency in the utilization of simulations. To meet milestone objectives requires flexible simulations that can readily be adapted to changing requirements in threat, performance, parameters or number of elements in the simulation. Ease of adaptability is key in providing an efficient simulation environment where time and cost are critical.

### MULTI-LEVEL FIDELITY

Simulations that provide multi-level fidelity are key to the efficient evaluation and development of strategic software. Simulations that can provide high fidelity modeling of an SDIO component such as a missile and yet be adapted to quickly simulate the entire GPALS scenario provide a broad base of uses. This also provides consistence between different levels of simulations when the same building blocks are used where the output of the components are consistent throughout the varying levels of fidelity.

### NON-INTRUSIVE TESTING

The need for non-intrusive test mechanisms and methodologies are particularly needed in the software area. As you know, it is impossible to effectively instrument software (insert "hooks") then collect and store data without perturbing the software function being tested. This is particularly true in real time functions where timing is critical. So, ideas are needed which will allow us to instrument and collect data during operations with minimal perturbation to timing and computer resources utilization (CPU time and memory).

## SOFTWARE

### Parallelized Systems

Recent technology advances and computational performance gains are in the area of massively paralleled processors connected together in various arrays and networks. These machines are great for some specific problems that can easily be "fitted" to their particular architecture. However, some problems require more ingenuity to partition and allocate across the parallel machine so as to take maximum advantage of its computational resources. In this area, software technology is needed to automate the process of converting those traditionally sequential functions to run in parallel.

### TESTING TOOLS/METHODOLOGIES

In the past, the accepted way to test software was to test it at the unit level by inputting a "range" of data inputs, execute the unit, check the outputs for accuracy or reasonableness. The units were then integrated into larger modules and tested with this process repeated until the total system is integrated. The problem with this methodology is that the all possible data ranges could not be inputted with all possible timing sequences.

As software systems have become larger and more complex, the integration process has led to timing/synchronization problems, data delays, control/lock-up problems and untested loops.

Static and dynamic testing software and methodologies are needed to alleviate these problems.

### VISUALIZATION

The age of sophisticated graphics and visualization is here. We now need to take full advantage of this technology to present test data and results of tests and analysis in the most optimum and understandable way possible. For instance, during an interceptor flight, it would be desirable to present selected telemetered flight data and ground support instrumentation data to project management personnel in formats that could be quickly understood. These formats could be tabular, bar graphics, etc... accompanied by data driven animation models.

Visualization has come a long way, but developing and rendering color models is still a slow and tedious process.

### HYPER MATRIX TOOLS

Solution of fluid flow and surface handling problems associated with high velocity flight of intercepting in the atmosphere require solutions to large matrix problems. Work is needed in the distribution of these problems across computational resources to optimize resources utilization and reduce the turnaround time for getting results.

The same multi-dimensional, large matrix problem is prevalent in high-fidelity simulation of these phenomena.

### ADA CAD/CAM

Computer Aided Software Engineering (CASE) tools are needed to maintain control and traceability of software and documentation from concept through final testing and delivery. These tools are needed for requirements traceability, configuration control, interface verification, documentation generation, and control and IV & V support. Software CAD/CAM or CASE tools are required for developing simulations and models as well as weapons systems software. Technology advances in this area are critical to the success of the SDI program.

### RESOURCE ACCOUNTING/MANAGEMENT

Improved, less intrusive tools are needed to collect and store information on CPU and I/O utilization for each account logged on to the computer. For security auditing purposes, information must be collected on classified files accessed and whether the files were modified.

Resource management tools are needed which automatically notify a requestor that he/she has resources scheduled. The automated management tool would then perform the required control functions to permit the user to log on to the allocated resources.

Automatic schedules/allocations should also be considered.

## NETWORKS

### HETEROGENEOUS INTERFACES

Industry's expertise in network technology and implementation methodology can be used in networking our testbeds and computers at the geographically distributed as well as at the local level.

Interfacing heterogeneous computers and networks refers to interfacing different kinds, different brands, different architecture machines such as VAXs and CRAYS. On the wide area or geographically distributed networks, ideas are needed in speeding up the transmission process while maintaining the ability to be highly interactive with smaller messages or data packet sizes.

Technology is needed to pass data between networks with unlike formats such as Ethernet and FDDI (Fiber-optic Digital Date Interchange).

### LOW LATENCY

Latency refers to the delay between the time a message is available to be sent from its origin until it is received by the requiring function at the destination. These delays may result from the waiting at the origin until a "full" message is ready to be sent; a delay results for the actual transmission time, say from the source to a geosynchronous satellite some 45,000 miles high in the "clark belt" and then from the satellite back to the destination somewhere on the earth. This problem is then amplified by the "handshaking" process which requires the receiver to acknowledge receipt of a message across the same transmission path before the next message is sent. Industry's ideas are needed to reduce latency and maintain acceptable bit error rate levels with minimum overhead.

### HIGH DATA TRANSFER RATES

Improved capability is needed in the transfer and movement of large amounts of data between elements and within command and control centers. High transfer rates are required for both large and small packets of data. A reduction in the overhead of routing and verification is important especially with small packet sizes of data. The routing and verification data is often larger than the data when transmission of small packets are required. There is considerable variation in transfer rates between different computers due to varying methods used in preparing data for transmission across the network. Improved standardization is needed as well as overall transfer rates.

### MLS CAPABILITIES

More and more, computers and their operating systems are beginning to be certified for managing data and executing software with different classification levels (i.e. Confidential and Secret).

Now suppose we all have two or more computers, each executing programs simultaneously at the "Confidential" and "Secret" levels. Now further suppose that the "Secret" program on computer A is required to communicate or send data to the "Secret" level program on computer B. Furthermore, suppose the same requirement true for the "Confidential" level programs. The requirement now exists for a "multi-level" network. This can be accomplished now, but the process is clumsy and expensive. Work needs to be done in this area.

### MULTIMEDIA CAPABILITIES

Networks must be able to support multimedia requirements. Data, voice, and visual information should share the same network to reduce the requirement for many single-use networks. To efficiently evaluate system and element performance requires the rest of multiple media forms to ensure the problem is being assessed with the optimum of information. Recent advances in fiber optics technology are beginning to provide this capability, but greater effort is needed in the interfacing and expansion of this technology.

## HARDWARE

### ELECTRONIC MASS DATA STORAGE

Improved technology for electronic mass storage of large amounts of data is required to support resolution of strategic defense critical issues. Data must be readily available to perform analysis and develop methods to improve system performance such as discrimination of objects in a cluttered environment. There are large volumes of data currently available and this data is growing at an ever increasing rate, yet the accessibility of this data is impeded by the lack of efficient electronic mass storage devices.

### HIGH END GRAPHIC WORKSTATION TECHNOLOGY

Visualization provides a tremendous advantage in the analysis of data that is critical to the success of strategic and theater defense systems. Improved workstations are required to run the sophisticated software being developed to provide visualization of the strategic defense challenges. Workstations require higher performing central processing units with large amounts of memory that are rapidly accessible. Efficient workstations are the key in reducing the development time of critical software.

## SECURITY

Hardware is required to meet the increasing security needs of the SDIO user community. Multi-level security systems provide for a more efficient use of assets. It also provides for a greater degree of security of data to prevent the loss of technology vital to strategic defense. Current systems that provide this capability are not state-of-the-art computers. The process to develop and validate security systems takes several years. Security systems should be developed as an integral part of the system that meets NSA requirements and must be rapidly verifiable.

### HIGH PERFORMANCE GATE ARRAYS

Improved high performance gate arrays or other circuit technologies which can be quickly adapted to high performance, highly specialized designs such as special interfaces or test/test control devices for signal and data processing. Higher performance gate arrays will improve the access and exchange of data required to meet SDIO element and command center requirements. Improve access between system components is critical to meet the throughput requirements for real time system components.



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FOI 92-0855



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# **SDIO Test and Evaluation**

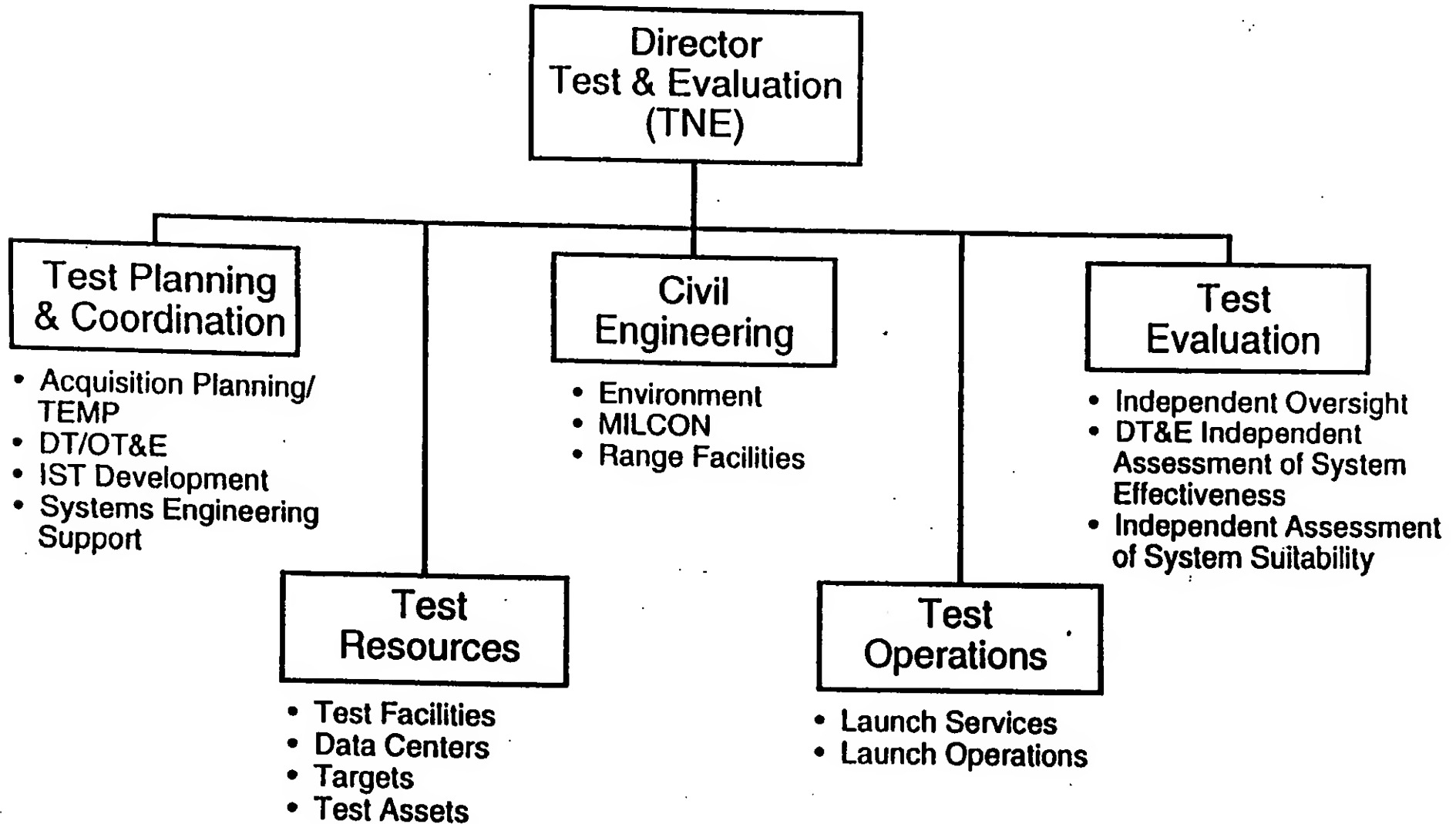
## **Advanced Planning Briefing for Industry**

**Col Michael T. Toole**  
**SDIO, Director of T&E**  
**February 1992**

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# TNE Service Organization





# SDI Test and Evaluation Role

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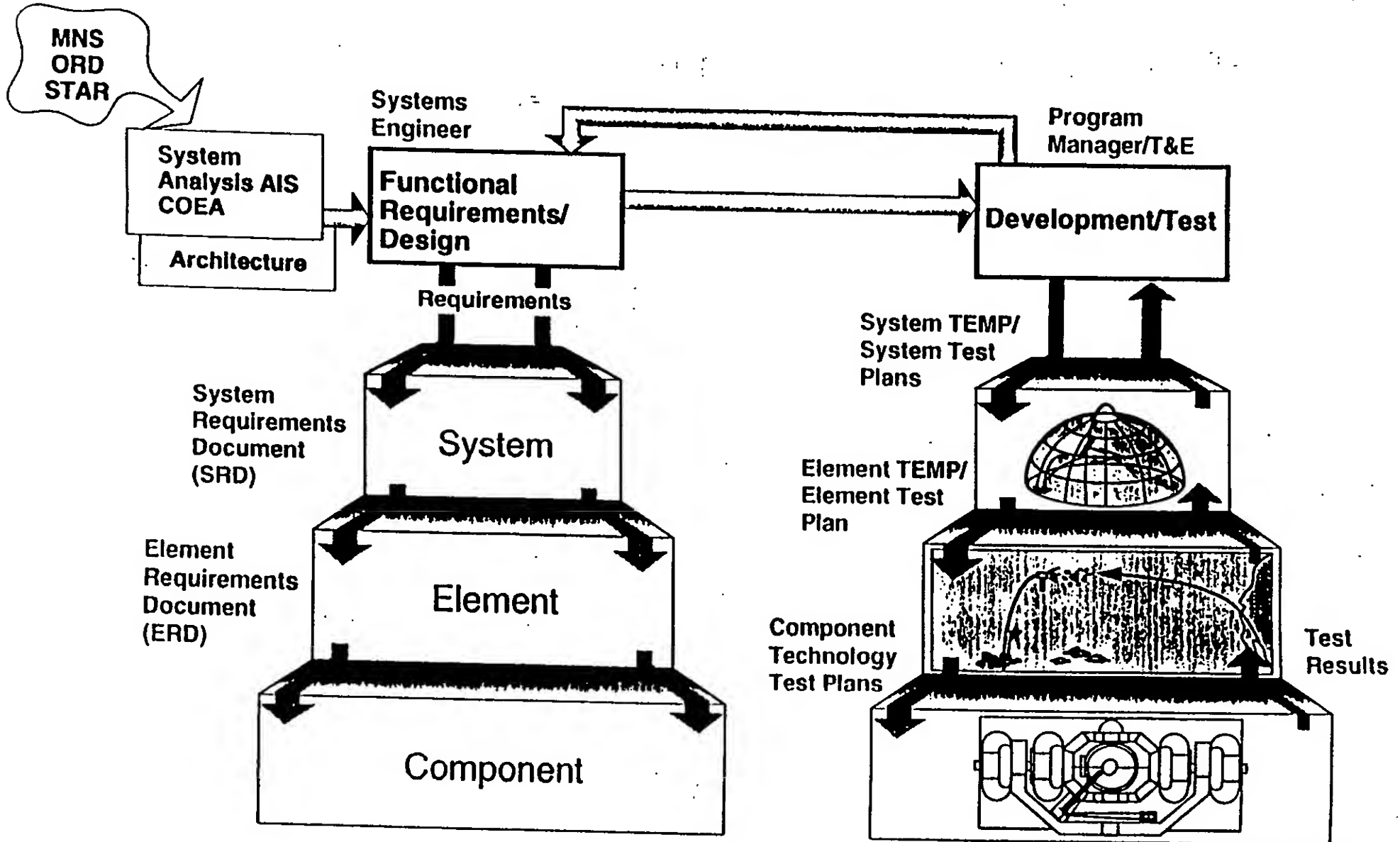
- Conduct Objective Test and Evaluation.
- Provide Accurate, Timely Information on Test Activities.
- Support National and Programmatic Decision Makers.

## **Through:**

- Coordinated Test Planning;
- Efficient Test Resource Management;
- Comprehensive Civil Engineering Support (MILCON, Environmental, Site Activation);
- Responsive Test Operations Services;
- Independent Evaluation.



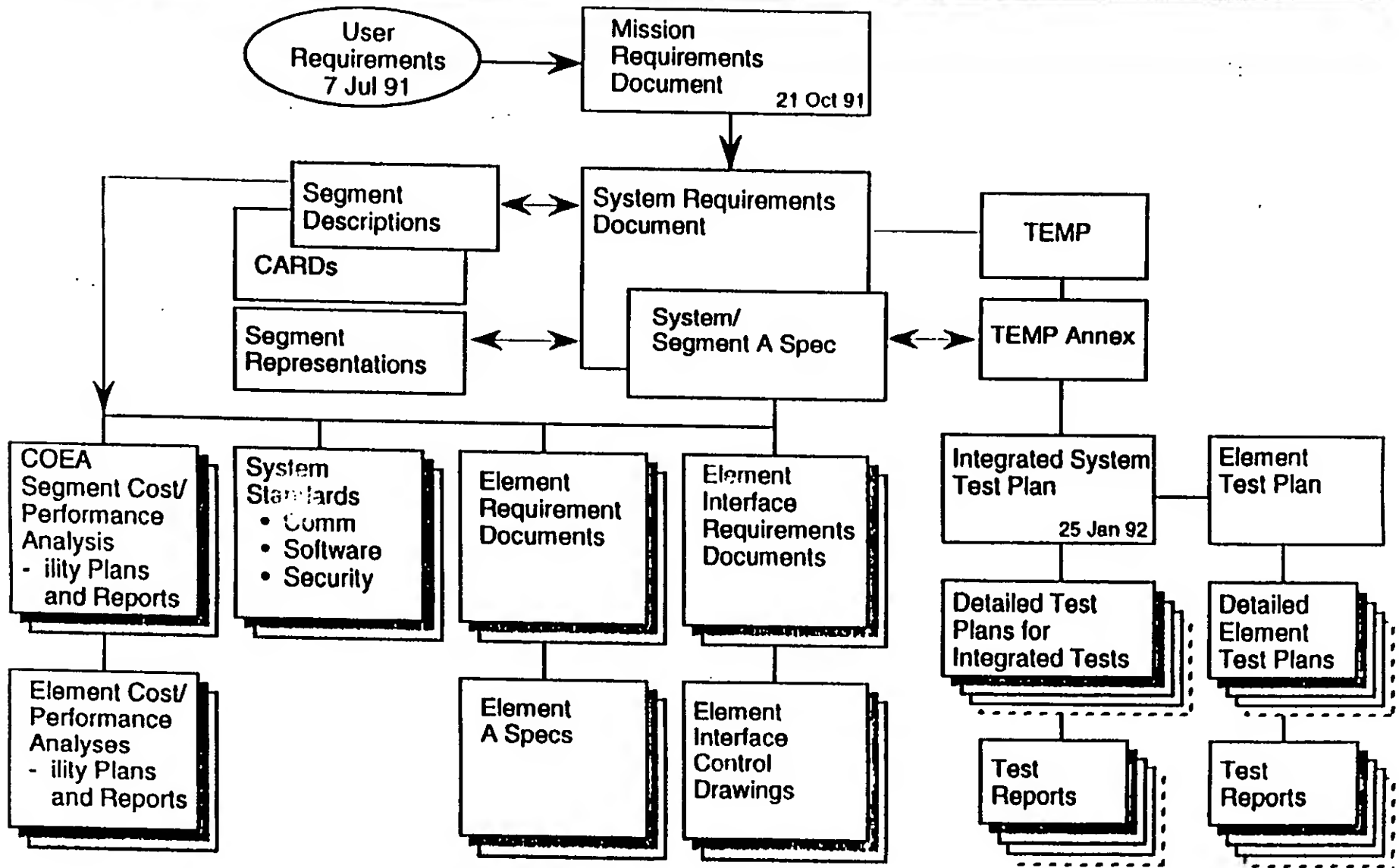
# Planning Process



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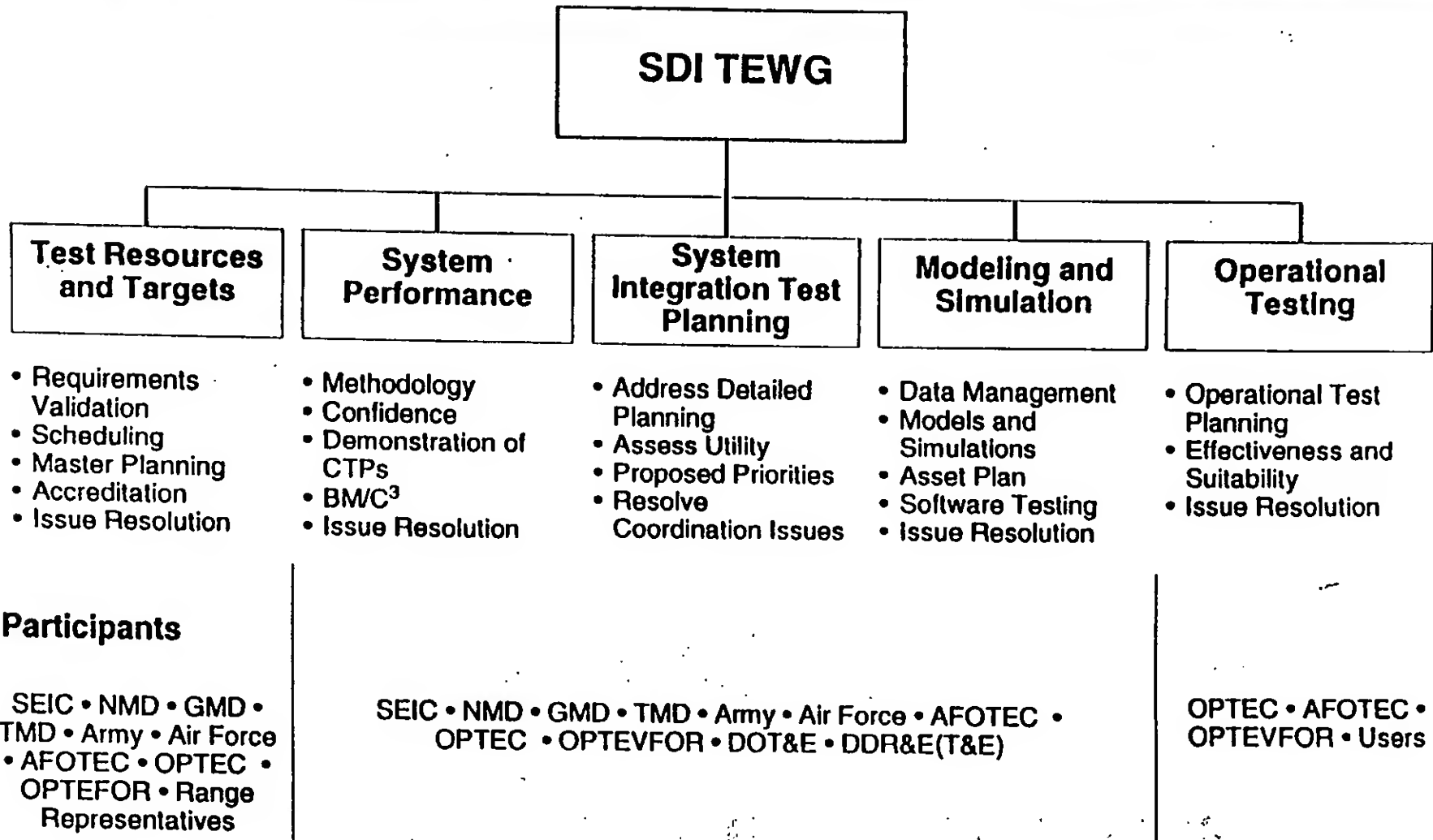


# Definition and Control of GPALS Segment Design Baseline



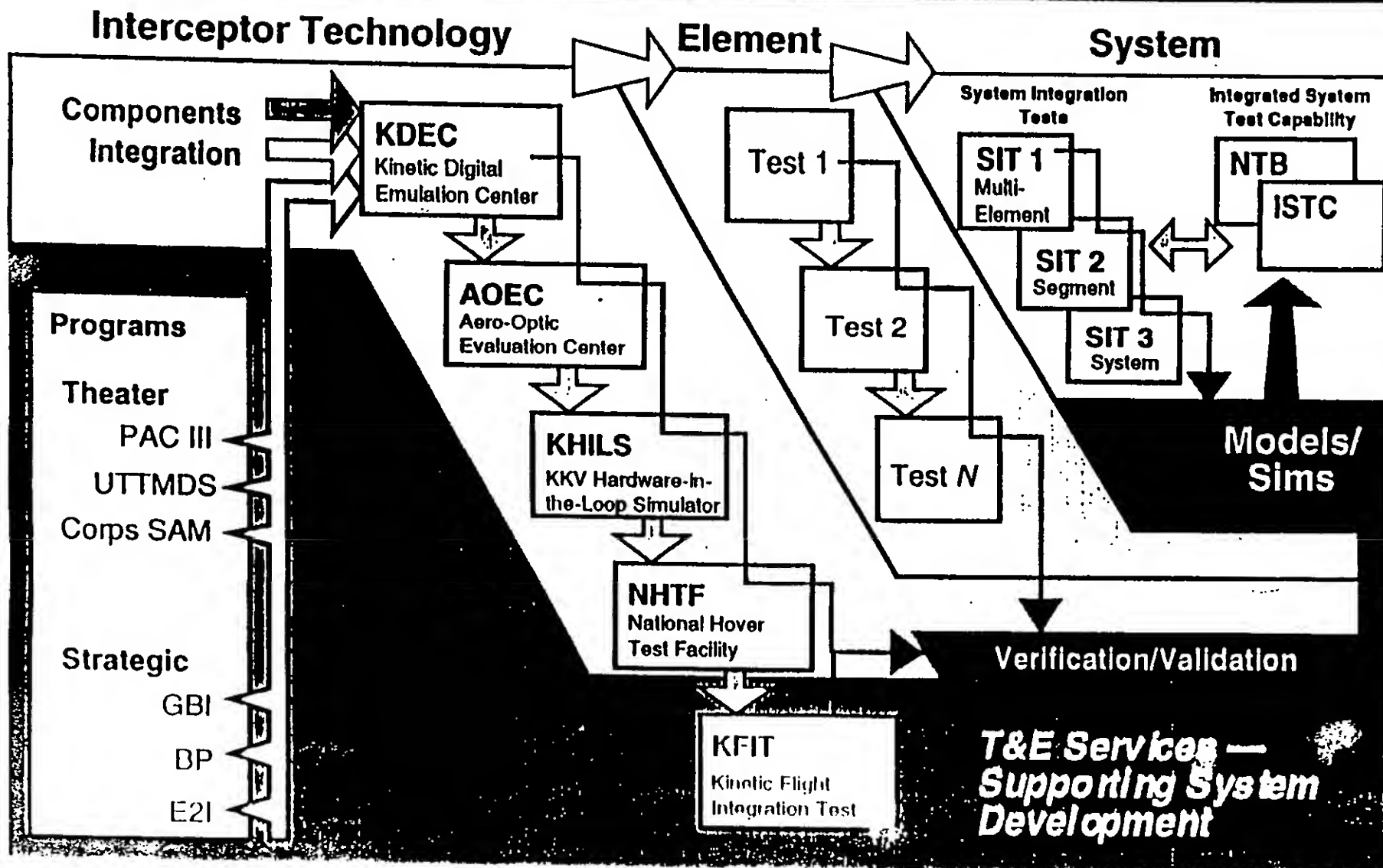


# SDI TEWG Subcommittees



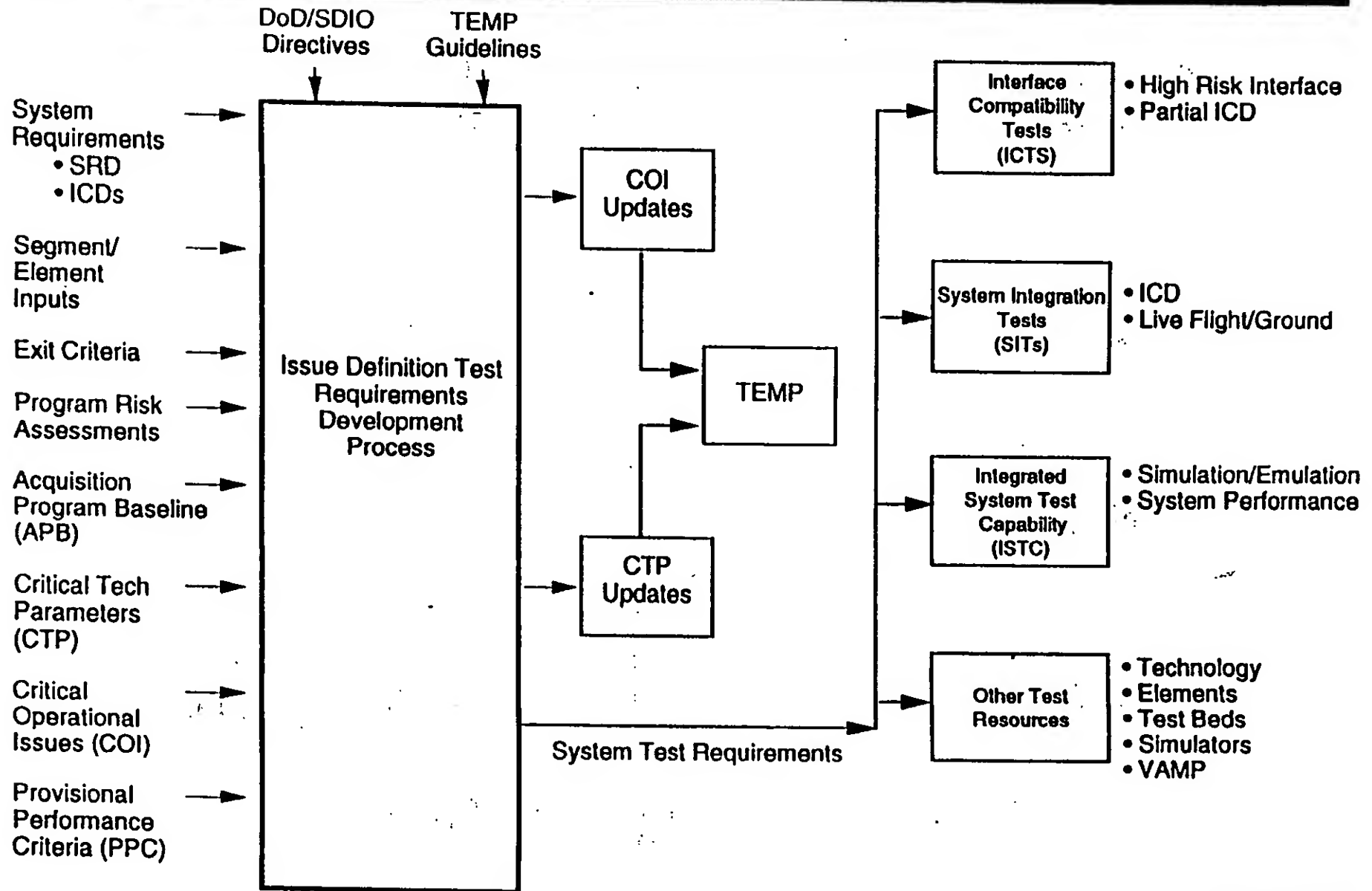


# Sample Test Process





# Test Requirements Development/Allocation







# System Test Concept Supports

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- Development Testing
- Operational Testing
- User Testing
- P<sup>3</sup>I Testing





# System Integration Tests

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## Objective

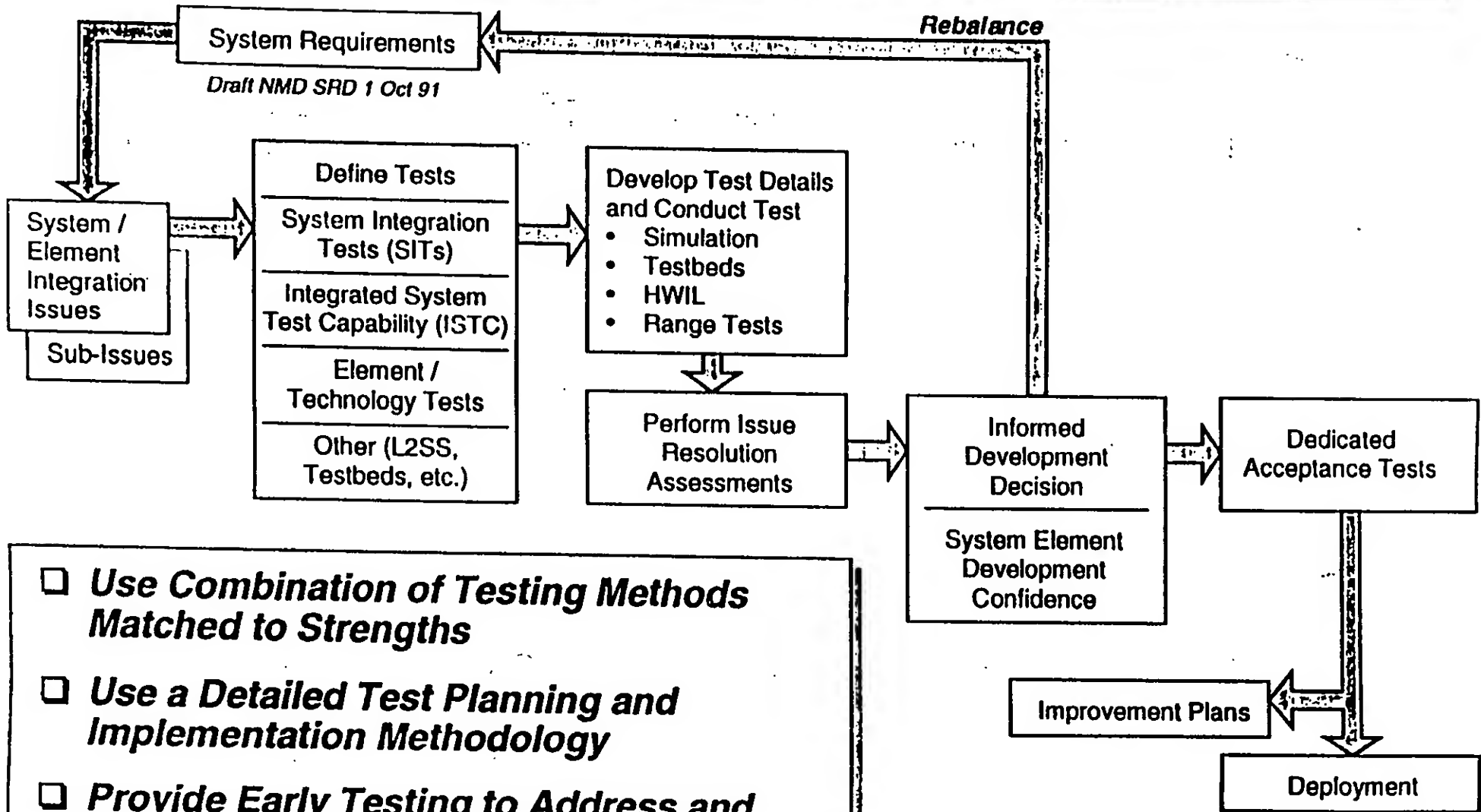
Initiate an Effort to Develop a Cost Effective Approach to Resolve System Integration Issues Using SITs and the ISTC as a Part of an Overall Test Program.

## Approach

- Force Requirements Flow Down
  - Define Performance Envelopes
  - Identify Critical Issues
  - Map Issues to Test Requirements
  
- Develop Integrated Testing Strategy
  - Identify Live Testing Requirements
  - Coordinate System Testing Activities
  
- Determine Executive Agent(s)
  - Planning/Execution/Evaluation
  
- Use Proven Experience and Resources



# Approach to Design of System Integrated Tests



- Use Combination of Testing Methods Matched to Strengths**
- Use a Detailed Test Planning and Implementation Methodology**
- Provide Early Testing to Address and Resolve Issues**



# Current Status

## Requirements That Should Be Tested

Requiring Ref	Req #	MOP(s) #	MOP Req #
SRD 3.2.1.1.3.2.1.2	R 1	1	1
SRD 3.2.1.1.3.1.1.6	R 2	2, 3	2, 2.5
SRD 3.2.1.1.3.1.b	R 3	4, 5	3
SRD 3.2.1.1.3.3.2.5	R 4	6	4
SRD 3.2.1.1.3.3.2.5	R 5	7	5
SRD 3.2.1.2.1	R 6	8	6
SRD 3.2.1.1.2.1	R 7	9	7
SRD 3.2.1.1.3.1	R 8	10	8
SRD 3.2.1.1.3.2.1.2	R 9	11	9
SRD 3.2.1.1.3.2.1.2	R 10	12	10
SRD 3.2.1.1.3.2.1.2	R 11	13	11
SRD 3.2.1.1.3.2.1.3	R 12	14	12
SRD 3.2.1.1.3.2.2.1.1.c	R 13	15	13
SRD 3.2.1.1.3.3	R 14	16	14
SRD 3.2.1.1.3.3.1	R 15	17	15
SRD 3.2.1.1.3.3.2	R 16	18	16
SRD 3.2.1.1.3.3.2.b	R 17	19	17
SRD 3.2.1.1.3.3.3.a	R 18	20	18
SRD 3.2.1.1.3.1.1.2.b	R 19	21, 22	19, 19.5
SRD 3.2.1.1.3.1.1.4.b	R 20	23	20, 20.5, 20.6
SRD 3.2.1.1.3.1.1.4.c	R 21	24	21, 21.5
SRD 3.2.1.1.3.1.1.4.d	R 22	25	22, 22.5
SRD 3.2.1.1.3.1.1.4.e	R 23	26	23
SRD 3.2.1.1.3.1.2.2.b	R 24	27, 28	24, 24.5
SRD 3.2.1.1.3.1.2.4.b	R 25	29	25, 25.5, 25.6
SRD 3.2.1.1.3.1.2.4.c	R 26	30	26, 26.5
SRD 3.2.1.1.3.1.2.4.d	R 27	31	27, 27.5
SRD 3.2.1.1.3.1.2.4.e	R 28	32	28

## Traceability

CTP
Battle Management
Surveillance
Surveillance
Communications
Battle Management
Battle Management
Human-In-Control
Surveillance
Battle Management
Battle Management
Battle Management
Battle Management
Kill Effectiveness
Kill Effectiveness
Battle Management
Kill Effectiveness
Communications
Kill Effectiveness
Surveillance
Battle Management
Battle Management
Kill Effectiveness
Surveillance
Surveillance
Battle Management
Battle Management
Kill Effectiveness
Surveillance

## Critical Issues That Can be Tested

Decomposed CTP	MOP	Units
Intercept Success	1	sec
Impact Point Prediction	2, 3	km, sec
Surveillance Tasking Response	4, 5	sec, sec
Reporting Capability	6	sec
Simultaneous Engagement	7	sec
Data Combination	8	sec
Threat Decision Support	9	sec
Surveillance Tasking Plans	10	sec
Kill Data Rate	11	sec
True Report	12	—
False Report	13	—
Keep Out Zone	14	sec
Weapon Tasking Plans	15	—
Minimum Engagement	16	—
Interceptor Select	17	sec
System Authorization	18	—
Receipt Report	19	sec
Effectiveness Value	20	—
Passive Search	21, 22	km, km/sec
Passive Commit Target Accuracy	23	meters
Final Uplink Target Accuracy-Passive	24	meters
Position of Object, Endgame-Passive	25	meters
Post-Intercept Passive Track	26	sec
Active Search	27, 28	km, km/sec
Active Commit Target Accuracy	29	meters
Final Uplink Target Accuracy-Active	30	meters
Position of Object, Endgame-Active	31	meters
Post-Intercept Active Track	32	sec



# SIT Planning Matrix

Opportunity	Prop. SIT No.	Involved Elements						Scheduled	ISTC	Targets	Remarks
		C2E	GBR	GSTS	GBI	EWS	BE				
1		Surr Funct	KREMS	AMOS AST	ERIS FTV 2	X		2/92		1	Sensor Weapon Handover KREMS-Lmt'd GBR Functionality
2		Surr Funct	KREMS	(EDX) AMOS AST	ERIS FTV-4	X	(MSX)	2/93		1	Acquire, Track, Disc., Engage. KREMS-Lmt'd GBR Functionality (EDX, MSX if Available)
3		Bld #2	GBR	1 GSTS	1 GBI	X		1/95	12 Node	1	Sensor Handover; GBI not Integrated (Data Merge Post Test)
4		Bld #2	GBR	1 GSTS	1 GBI	X	(1 BE)	3/95	12 / 38 Node	1	Full 1 on 1 Engagement with C2E (Bld #2)
5		Bld #3	GBR	2 GSTS	2 GBI	X	(1 BE)	1/96	38 Node	1	Full 2 on 1 Engagement with C2E (Bld #3); Tactical H/W
6		Bld #3	GBR	2 GSTS	Multiple GBI	X	(1 BE)	2/96	38 / 100 Node	2	Full 4 on 2 Engagement with C2E (Bld #3); Tactical H/W; S/W
7		Bld #3	GBR	2 GSTS	Multiple GBI	X	(1 BE)	4/96	38 / 100 Node	2	Dedicated OT (4 on 2)

**Significant Resources**

- 1 GBR
- 15 GBI
- 9 Targets
- 8 GSTS
- Tactical Launch System at KMR
- C2E Bld #3 H/W - S/W, Needed 4Q95, or very early 96.

(17)



# SIT Planning Matrix

Opportunity	Prop. SIT No.	Involved Elements						Scheduled	ISTC	Targets	Remarks
		C2E	GBR	GSTS	GBI	EWS	BE				
1		Surr Funct	KREMS	AMOS AST	ERIS FTV 2	X		2/92		1	Sensor Weapon Handover KREMS-Lmtd GBR Functionality
2		Surr Funct	KREMS	(EDX) AMOS 'AST	ERIS FTV-4	X	(MSX)	2/93		1	Acquire, Track, Disc., Engage. KREMS-Lmtd GBR Functionality (EDX, MSX if Available)
3		Bld #2	GBR	1 GSTS	1 GBI	X		1/95	12 Node	1	Sensor Handover; GBI not Integrated (Data Merge Post Test)
4		Bld #2	GBR	1 GSTS	1 GBI	X	(1 BE)	3/95	12 / 38 Node	1	Full 1 on 1 Engagement with C2E (Bld #2)
5		Bld #3	GBR	2 GSTS	2 GBI	X	(1 BE)	1/96	38 Node	1	Full 2 on 1 Engagement with C2E (Bld #3); Tactical H/W
6		Bld #3	GBR	2 GSTS	Multiple GBI	X	(1 BE)	2/96	38 / 100 Node	2	Full 4 on 2 Engagement with C2E (Bld #3); Tactical H/W; S/W
7		Bld #3	GBR	2 GSTS	Multiple GBI	X	(1 BE)	4/96	38 / 100 Node	2	Dedicated OT (4 on 2)

**Significant Resources**

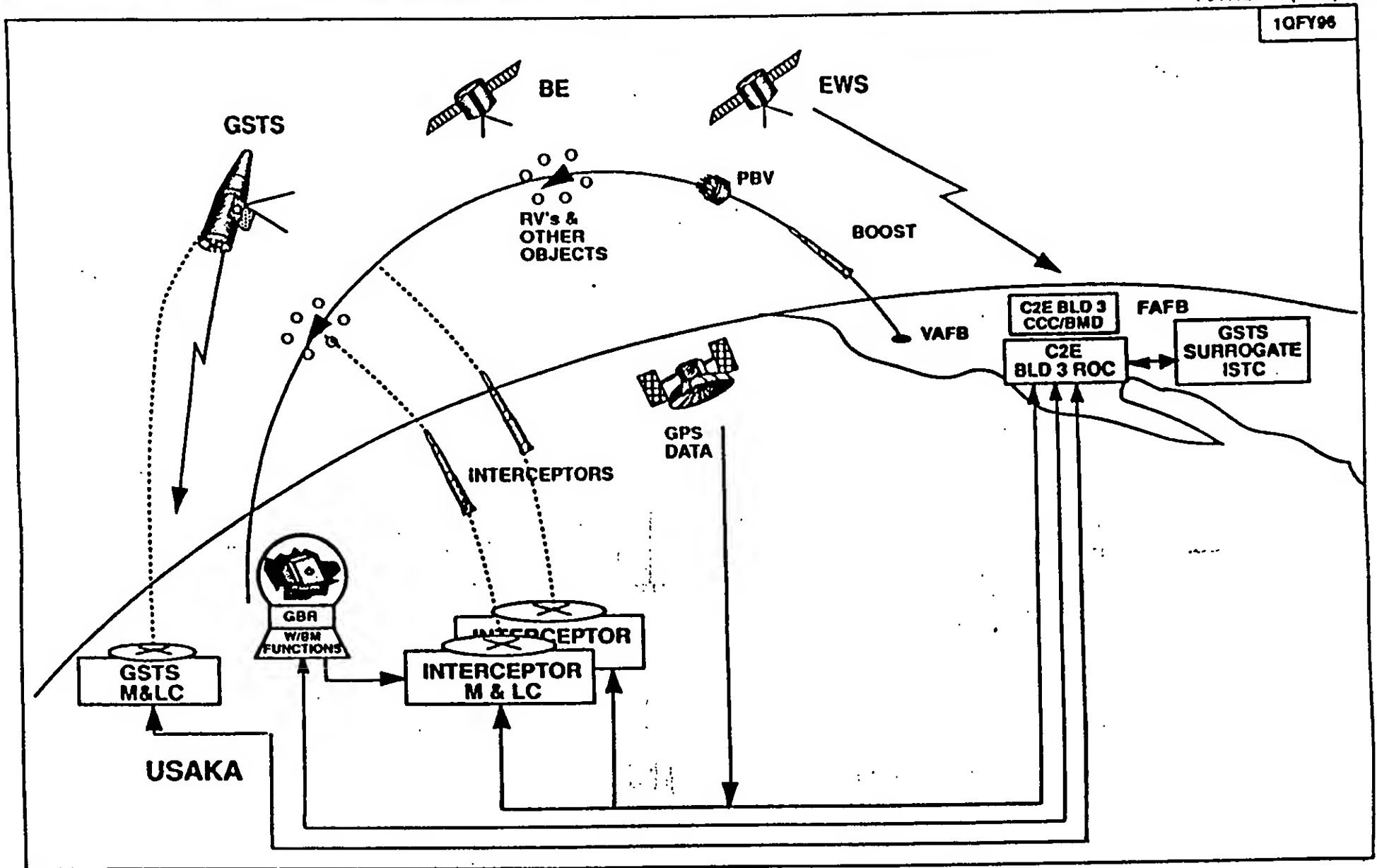
- 1 GBR
- 15 GBI
- 9 Targets
- 8 GSTS
- Tactical Launch System at KMR
- C2E Bld #3 H/W - S/W, Needed 4Q95, or very early 96.

17

# SIT 5, SYSTEM DEMONSTRATION RANGE TEST (2 ON 1)

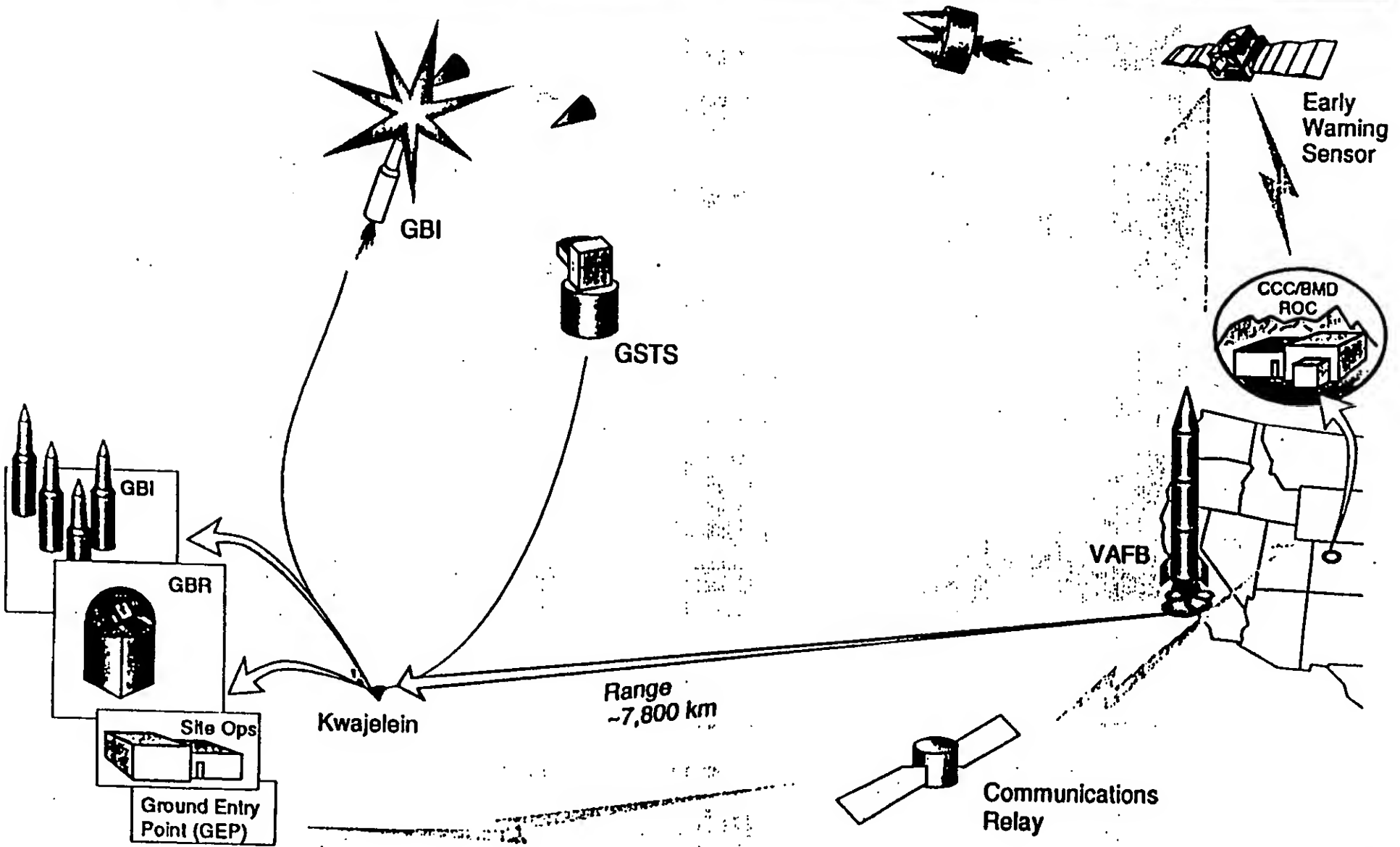
I-911120-04 (0323)

10FY96





# NMD Test Scenario







# Preliminary Mapping of 28 "Testable Requirements" Traced to SITs

NMD Issue Categories & CTPs	Req't No.	1 2/92	2 2/93	3 1/95	4 3/95	5 1/96	6 2/96	7 4/96
<b>SURVEILLANCE</b>								
Impact Point Prediction	2							
Surveillance Tasking Response	3							
Surveillance Tasking Plans	8							
Passive Search	19							
Post-Intercept Passive Track	23							
Active Search	24							
Post-Intercept Active Track	28							
<b>BATTLE MANAGEMENT</b>								
Intercept Success	1							
Simultaneous Engagement	5							
Data Combination	6							
Kill Date Rate	9							
True Report	10							
False Report	11							
Keepout Zone	12							
Interceptor Select	15							
Passive Commit Target Accuracy	20							
Final Uplink Target Accuracy-Passive	21							
Active Commit Target Accuracy	25							
Final Uplink Target Accuracy-Active	26							
<b>COMMUNICATIONS</b>								
Reporting Center	4							
Receipt Report	17							
<b>KILL EFFECTIVENESS</b>								
Weapon Tasking Plans	13							
Minimum Engagement	14							
System Authorization	16							
Effectiveness Value	18							
Position of Object, Endgame-Passive	22							
Position of Object, Endgame-Active	27							
<b>HUMAN-IN-CONTROL</b>								
Threat Decision Support	7							

	No/ Limited Relevant Data
	Some Data to Assess Requirement
	Data to Qualify Spec/ CTPs



# Integrated System Test Capability

---

## Objective

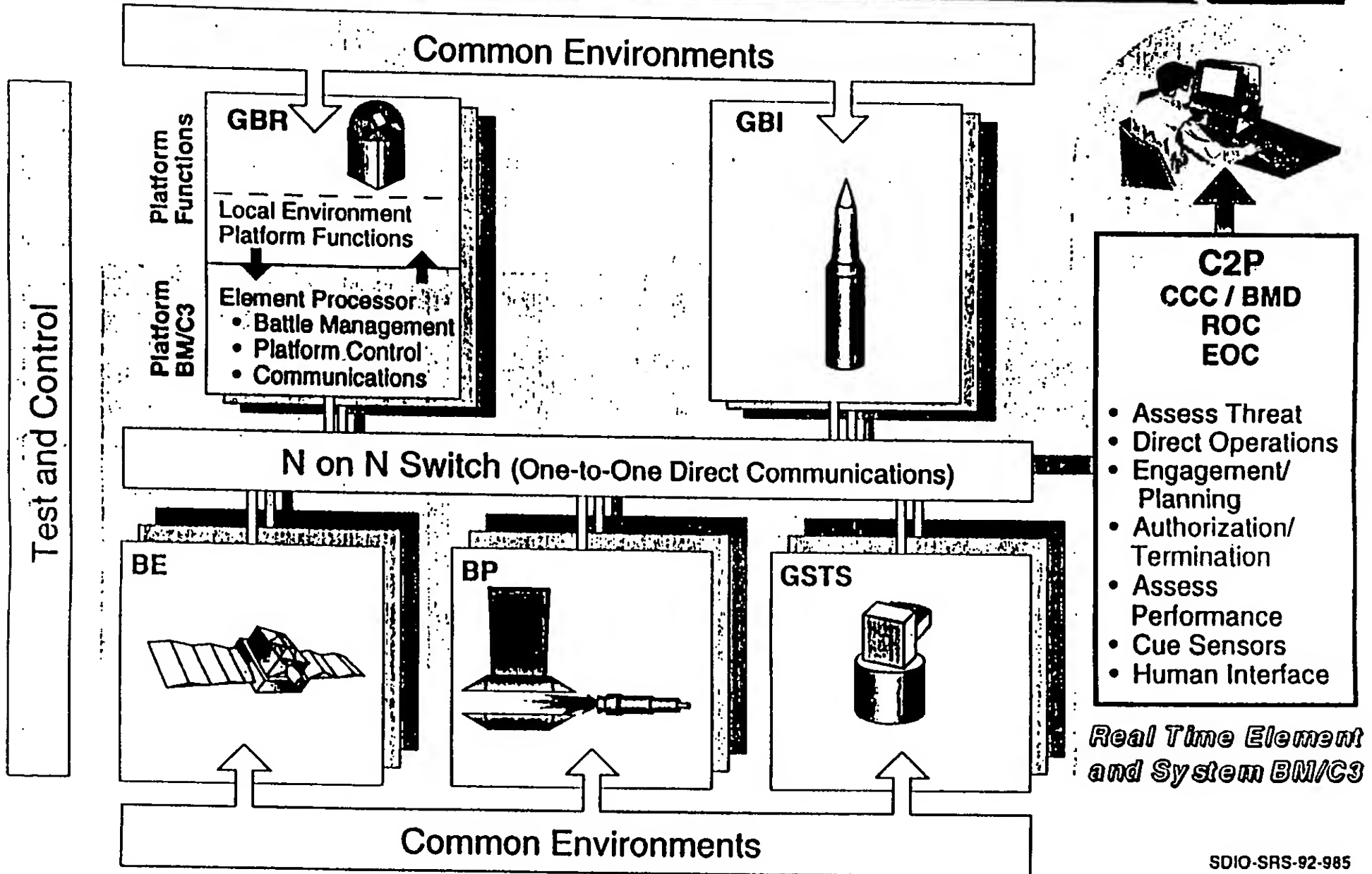
- Develop a Real-Time, HWIL Testing Capability To Conduct Statistically Significant Iterations for Integrated System Performance Assessment
- Provide the Ability to Extend the Test Envelope to Include Stressing Environments and Fully Representative System Operation

## Approach

- Design the Tool to be a Valid Representation of the Full GPALS
  - Model Each Element Platform Independently in HW and SW
  - Incorporate Actual Element Hardware and Software
- Develop the ISTC to Support Engineering Integration, Operational Testing, and User Training
- Include DT and OT Representation in Development Process to Ensure ISTC Validation and Accreditation



# ISTC Architecture



*Real Time Element and System BM/C3*



# Integrated System Test Capability

---

- Provide Engineering Integration Between Elements
  - Algorithms
  - ICD Testing/Demonstration
- Predict Performance of USAKA System Integration Tests
- Validate System and Segment Performance
- Provide Operational Test Resource
- Provide User Training Resource

# ISTC Development Activities

FY92

FY93

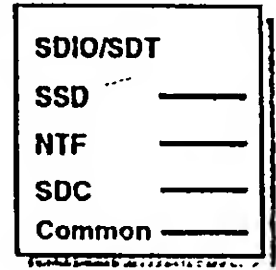
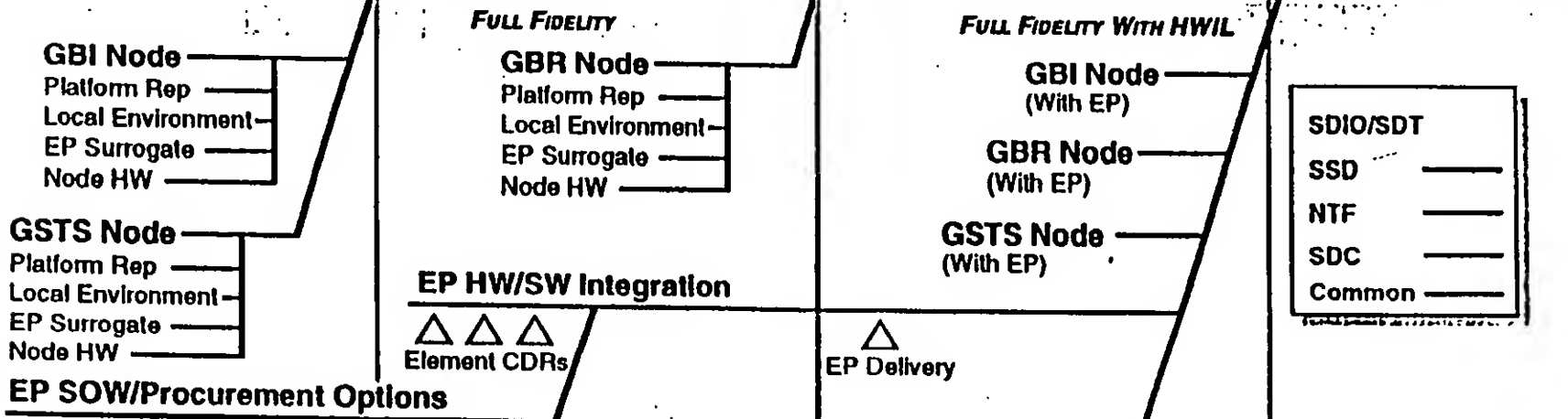
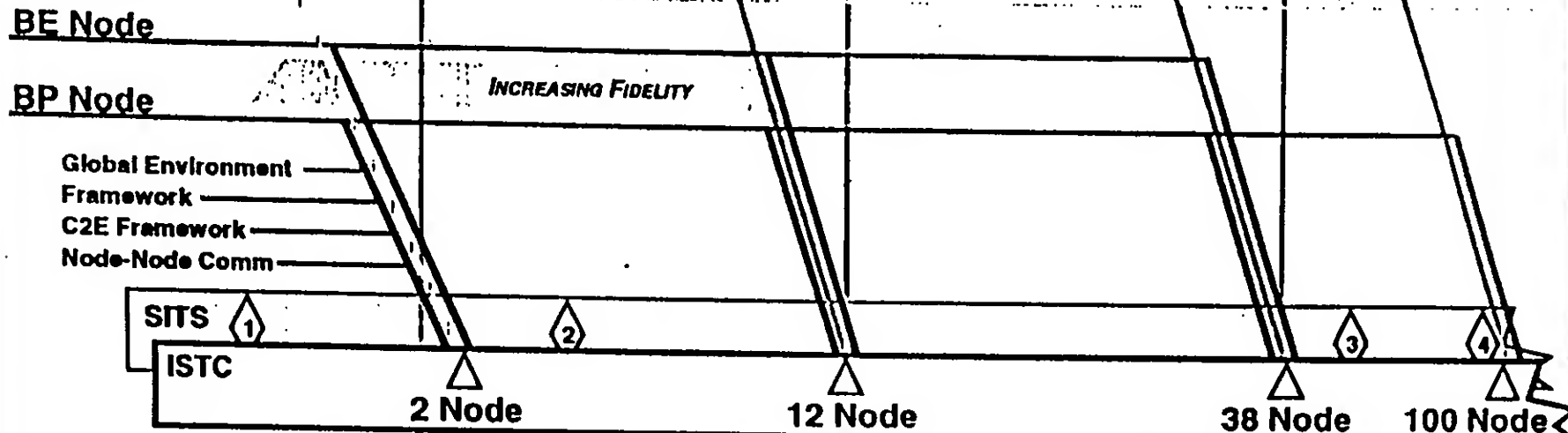
FY94

FY95

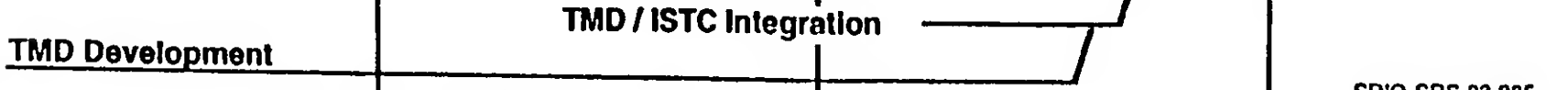
SDIO/  
SDA



SDIO/  
TNE  
SDT



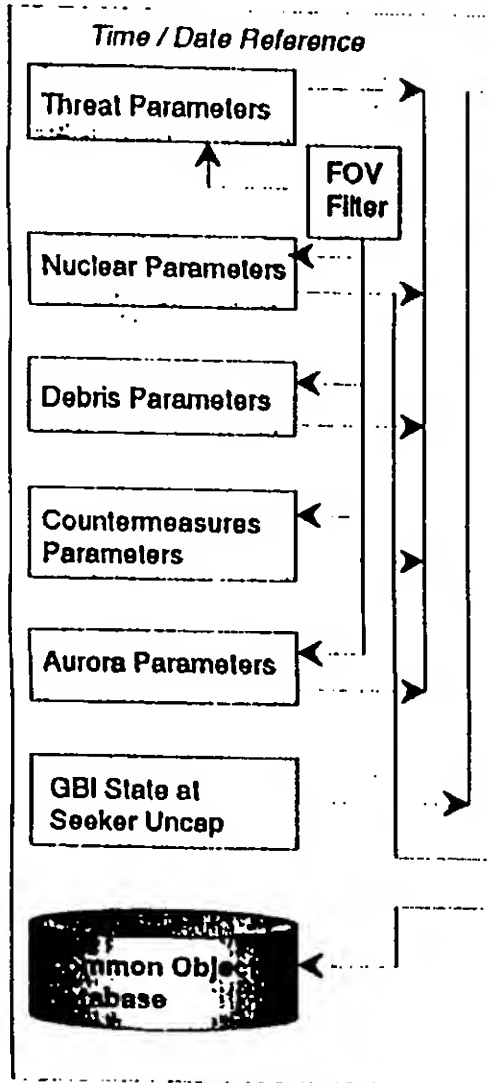
SDIO/  
TD



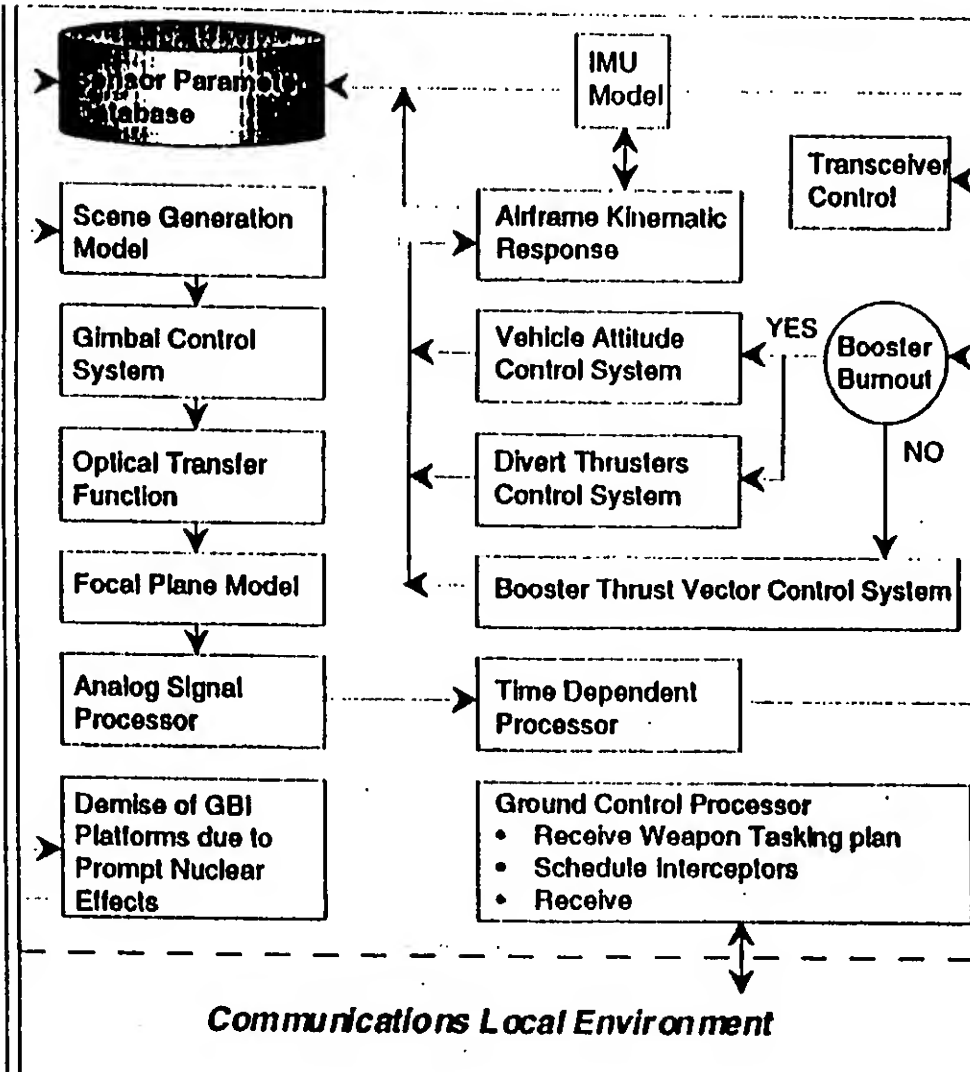


# GBI Functional Flow

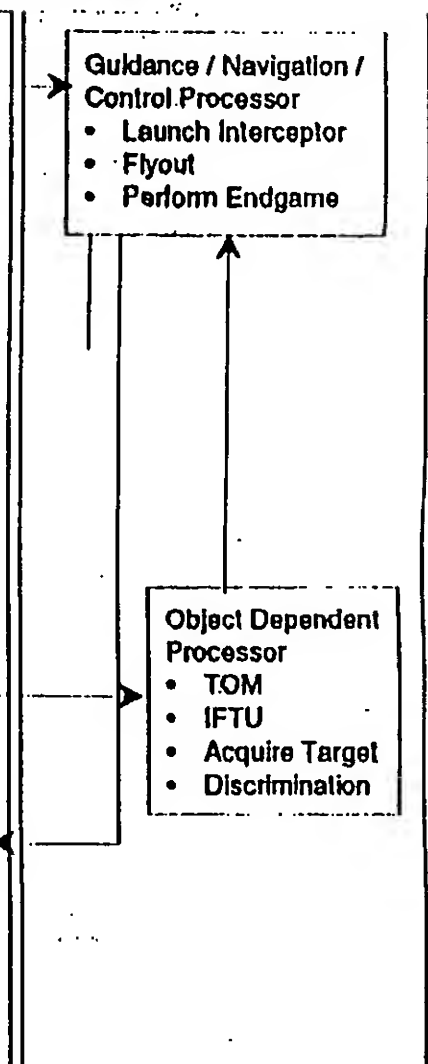
## Common Environment



## GBI Unique Environment



## GBI Element Processor



121



# C2E Functional Flow

## Common Environment

Time / Date Reference

Threat Parameters

Nuclear Parameters

C2E Initial Positions  
(at T<sub>zero</sub>)

## C2E Unique Environment

CCE

TW / AA

NMCS

IOC

Communications Local Environment

## C2E Element Processor

CCC / BMD

BMD Attack Assess / Characteristics

System Performance Assessment

Engagement Authorization / Termination

Select / Mod Pro / DEO / ECD

ODC

ECD Selection

System Activation

Engagement Authorization / Termination



# ISTC Planning Matrix

ISTC Conflg	Involvement Elements							Sched.	ISTC	Targets	Remarks
	C2E	GBR	GSTS	GBI	COM3 HW	BE	BP				
0	Build 0		PL Rep LE EP Sur	PL Rep LE EP Sur				1/93	2 Node		<ul style="list-style-type: none"> <li>Global Environment</li> <li>Framework</li> <li>C2E Framework</li> </ul>
1	Build 1	PL Rep LE EP Sur	PL Rep LE EP Sur	PL Rep LE EP Sur				1/94	12 Node		<ul style="list-style-type: none"> <li>Available for GPALS Utilization</li> <li>Use for SIT 3 Prediction</li> </ul>
2	Build 2	PL Rep LE EP	PL Rep LE EP	PL Rep LE EP	X	PL Rep LE EP		1/95	38 Node		<ul style="list-style-type: none"> <li>Use as NMD System Performance Tool Following SIT 3</li> </ul>
3	Build 3	↓	↓	↓	↓	↓		1/96	38 Node		<ul style="list-style-type: none"> <li>Use as GPALS System Performance Tool Allocate</li> </ul>
4	Build 3	↓	↓	↓	↓	↓		1/97	XXX Node		<ul style="list-style-type: none"> <li>38 Node Tool to GPALS SIT Predictions</li> </ul>
5	Build 4										
TBD											

PL Rep = Platform Representation  
 LE = Local Environment  
 EP = Element Processor  
 Sur = Surrogate

61





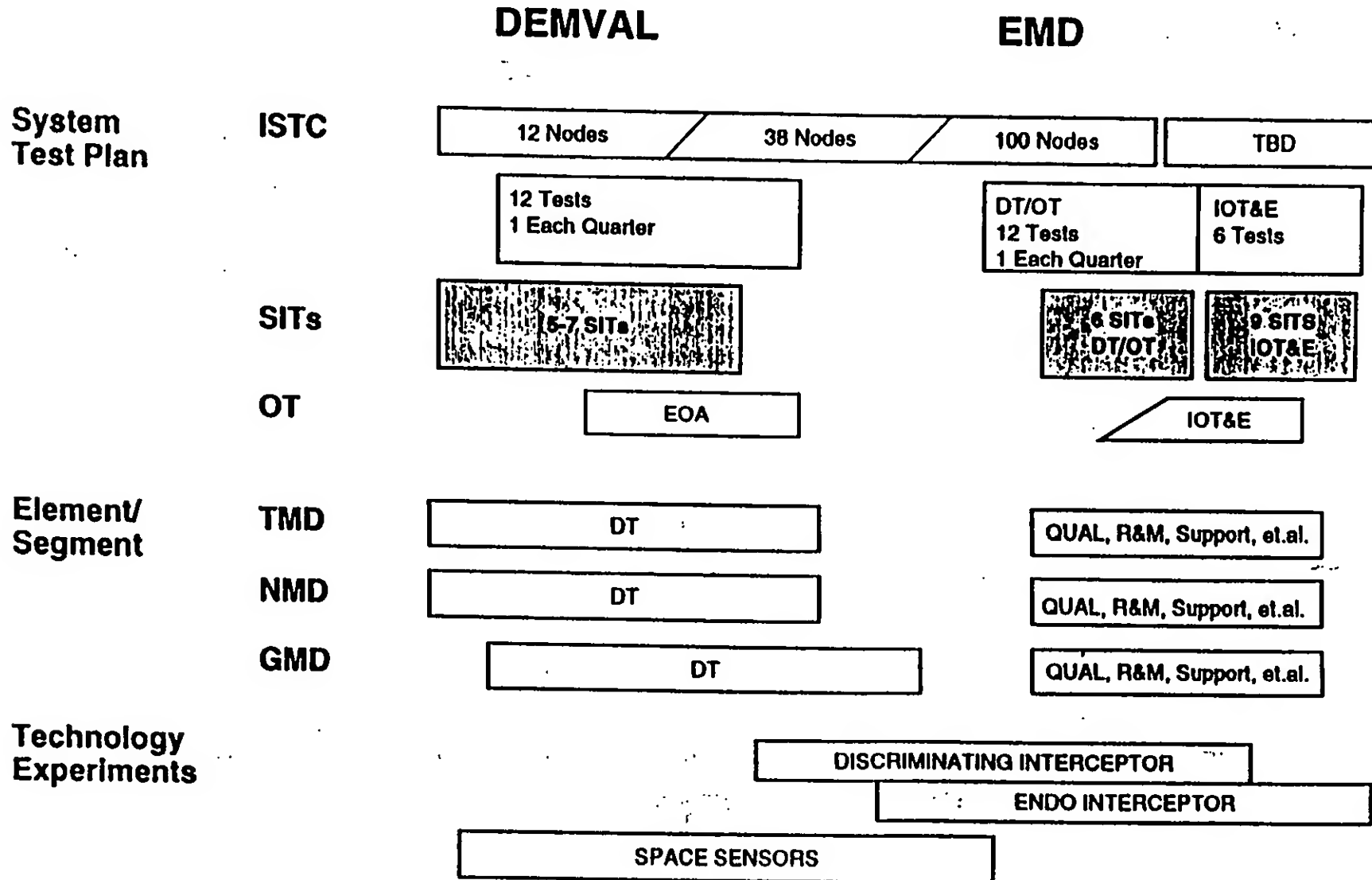
# Element Impacts From System Testing

<b><i>ICTs</i></b>	<ul style="list-style-type: none"><li><input type="checkbox"/> Elements Required to Provide Windows of Opportunity in Their Test Schedules for Interface Testing with Other Elements of Critical Interface Functions / Requirements</li></ul>
<b><i>SITs</i></b>	<ul style="list-style-type: none"><li><input type="checkbox"/> Elements Required to Supply Test Articles in Sufficient Number to Meet Schedules for SIT Testing.</li><li><input type="checkbox"/> Test Articles Will be Functionally Complete "Platforms", e.g., A GBI, a GSTS, etc.</li></ul>
<b><i>ISTC</i></b>	<ul style="list-style-type: none"><li><input type="checkbox"/> Elements Required to Supply Test Articles in Sufficient Number to Meet Schedules for ISTC Testing.</li><li><input type="checkbox"/> Test Articles Will be Functionally Complete "Processors" with Hardware and Software, e.g., a GSTS "Object Dependent Processor", a GBI "Guidance / Navigation Control Processor", etc.</li></ul>



# System CARD

## SITs and ISTC Phasing





# T&E Resources Policy

---

- Use Existing Test Resources Where Possible
- Before Initiating New Resources, Coordinate with T&E
- Consolidate Existing Resources



# Test Resources

MNS  
ORD  
STAR

**System  
Analysis AIS  
COEA**

Architecture

Systems Engineer

**Functional  
Requirements/  
Design**

Program Manager/T&E

**Development/  
Test**

**Testbeds (TB)  
(Models/Sims)**

EADTB, UKTB, ISTB  
BP SIM

Level 1 System  
Simulator (L1SS)

L2SS  
ISTC

C2TB  
CNE  
HICTB

C2 Prototype  
(C2P)

KDEC

Surveillance (STB)  
Weapons (WTB)

Various Engineering  
Models

LSTC (7V / 10V) , KHILS, NHTF, AMOS,  
CERES, Milstone Hill Radars

USNS Redstone, AST, HALO, ARGUS, COBRA EYE ,  
COBRA JUDY, COBRA BALL

USAKA, Wake Island, ESMC LC20  
WSMC, WSMR, PMRF

Plume, Midcourse, Background

TTV, ATV, SMRV, ODES, PENAIDS,  
STARS, MM, ...

**Facilities**

**Mobile Assets**

**Ranges**

**Data Center  
Targets**



# Civil Engineering and Environmental

---

## *Advance Planning Activities*

- Environmental Documentation and Siting Analysis
- Real Property Engineering Studies
- Facility Design Requirement Definition
- Geologic and Topographic Surveys
- Site Activation Facilities
- Facility Refurbishment
- Construction Contracts Anticipated in FY93



# Test Operations

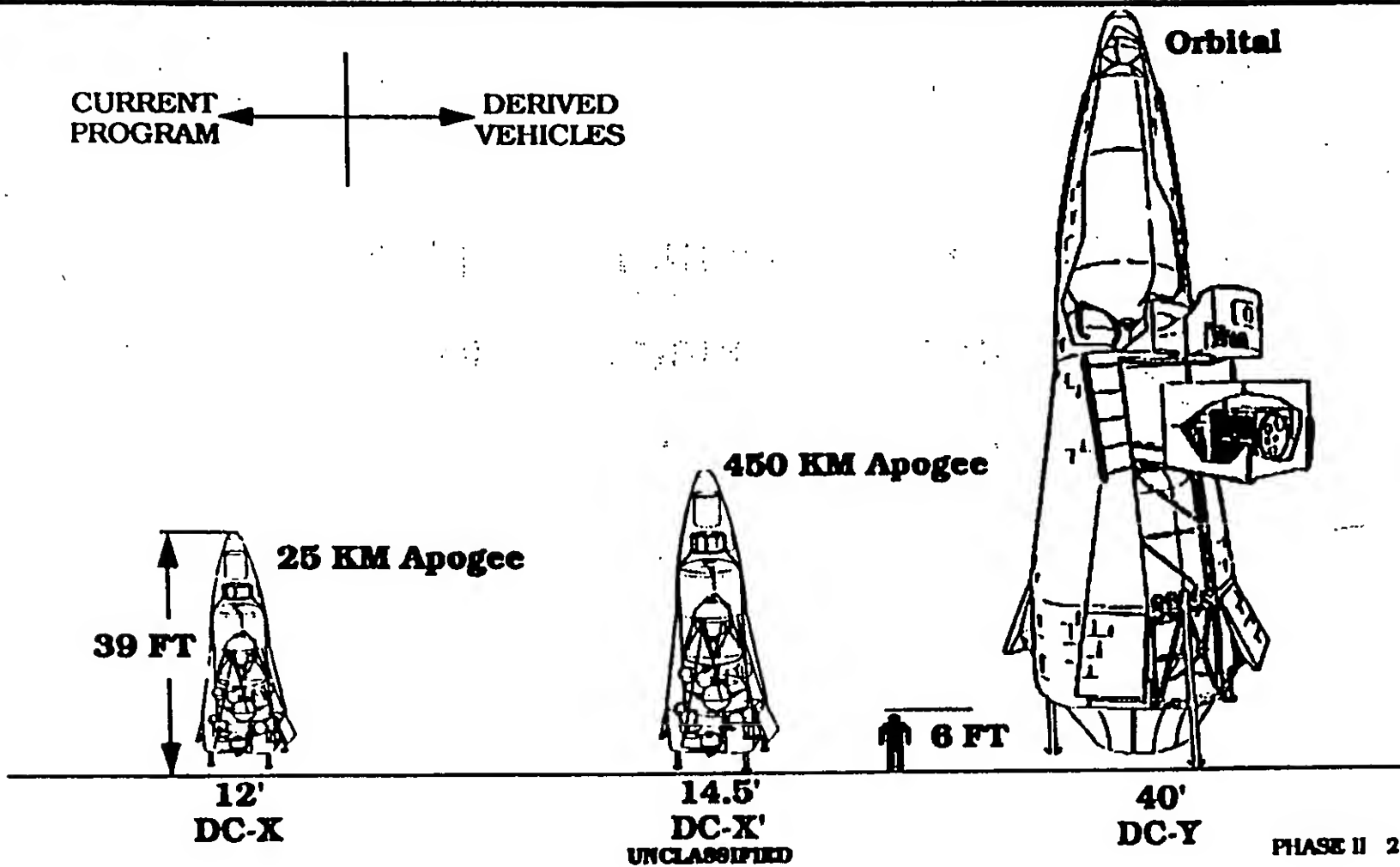
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- FY93 Procurement
- Full and Open Competition
- Suborbital Launch Services for FY94-97
- Number of Launches TBD



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## POTENTIAL DERIVED VEHICLES





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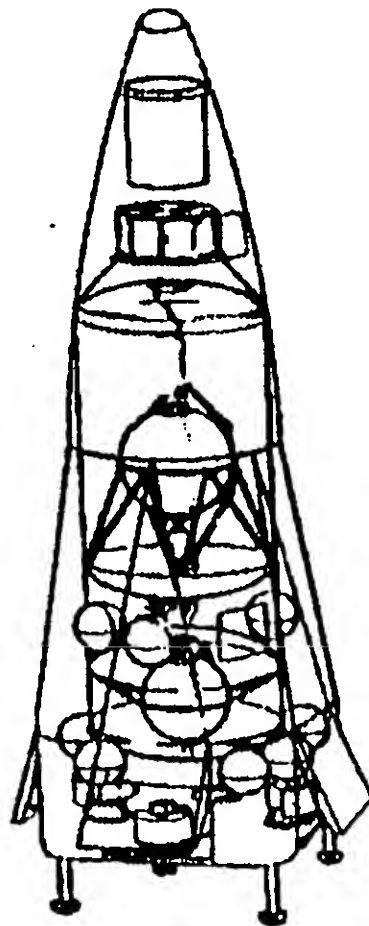
## PHASE II DC - X DESIGN 1/3 SIZE OF DC-Y

### MATERIALS & STRUCTURES

- Aluminum & Steel Tanks
- Aluminum Intertank & thrust structure
- Graphite epoxy aeroshell

### REACTION CONTROL SYSTEM

- $\text{GO}_2/\text{GH}_2$  Thrusters



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### PROPULSION SYSTEM

- Four RL-10's modified for sea level start & throttling



### VEHICLE CHARACTERISTICS

Base diameter	12 ft
Vehicle height	39 ft
Gross lift-off weight	35,980 lb
• Payload experiment	500 lb
Empty weight	15,940 lb

PHASE II 4





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# SCHEDULE

## INCREMENTAL DEVELOPMENT APPROACH

FISCAL YEAR	90	91	92	93	94	95	96	97	98	99	00
Phase I Concept Exploration	Design Selection		Final Reviews		\$15M	4-WAY AIRFRAME COMPETITION					
Phase II Prototype Design & Flight Demonstration		RFP	ATP	IDR	FDR	DC-X Fabrication	Flight Test	DC-Y Prototype Design	Hardware Demos	\$60M	
Phase III Experimental Prototype							1st Flight	SSTO			
Phase IV Operational System	NON SDIO ACTIVITIES										IOC

■ COMPLETED

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PHASE II 6

(31)

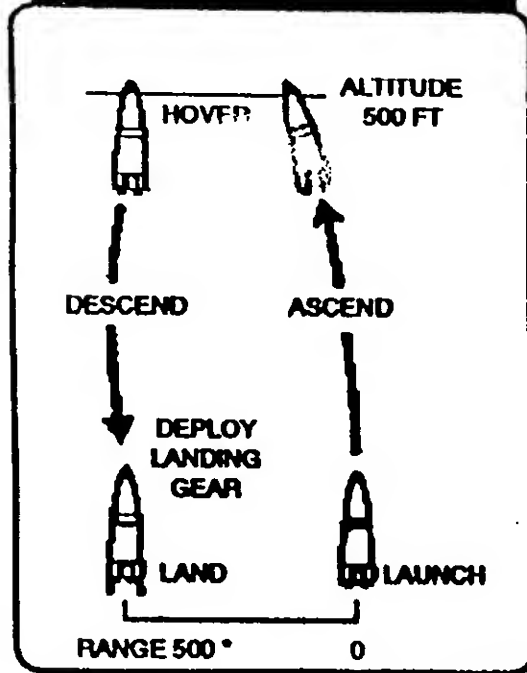


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## PHASE II WSMR FLIGHT TEST PROGRAM

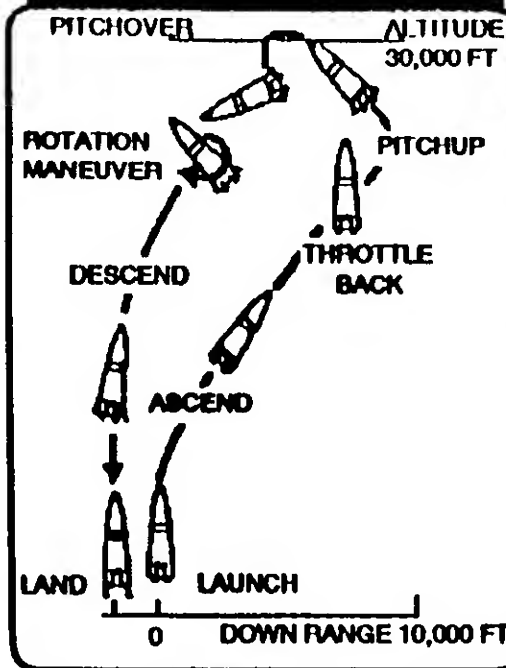
### AIRCRAFT ENVELOPE EXPANSION - - NO DESTRUCT PACKAGE

**FLIGHT TEST SERIES 1**



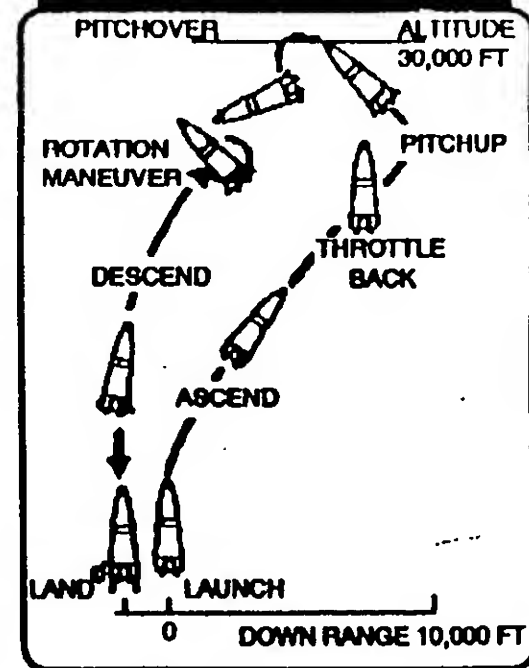
- LAUNCH & ASCEND
- DIFFERENTIAL THROTTLING CONTROL
- RCS ROLL CONTROL
- DESCEND & LAND

**FLIGHT TEST SERIES 2**



- AERODYNAMIC LIFT UNDER LOWER POWER THROUGH APOGEE
- ROTATION MANEUVER

**FLIGHT TEST SERIES 3**



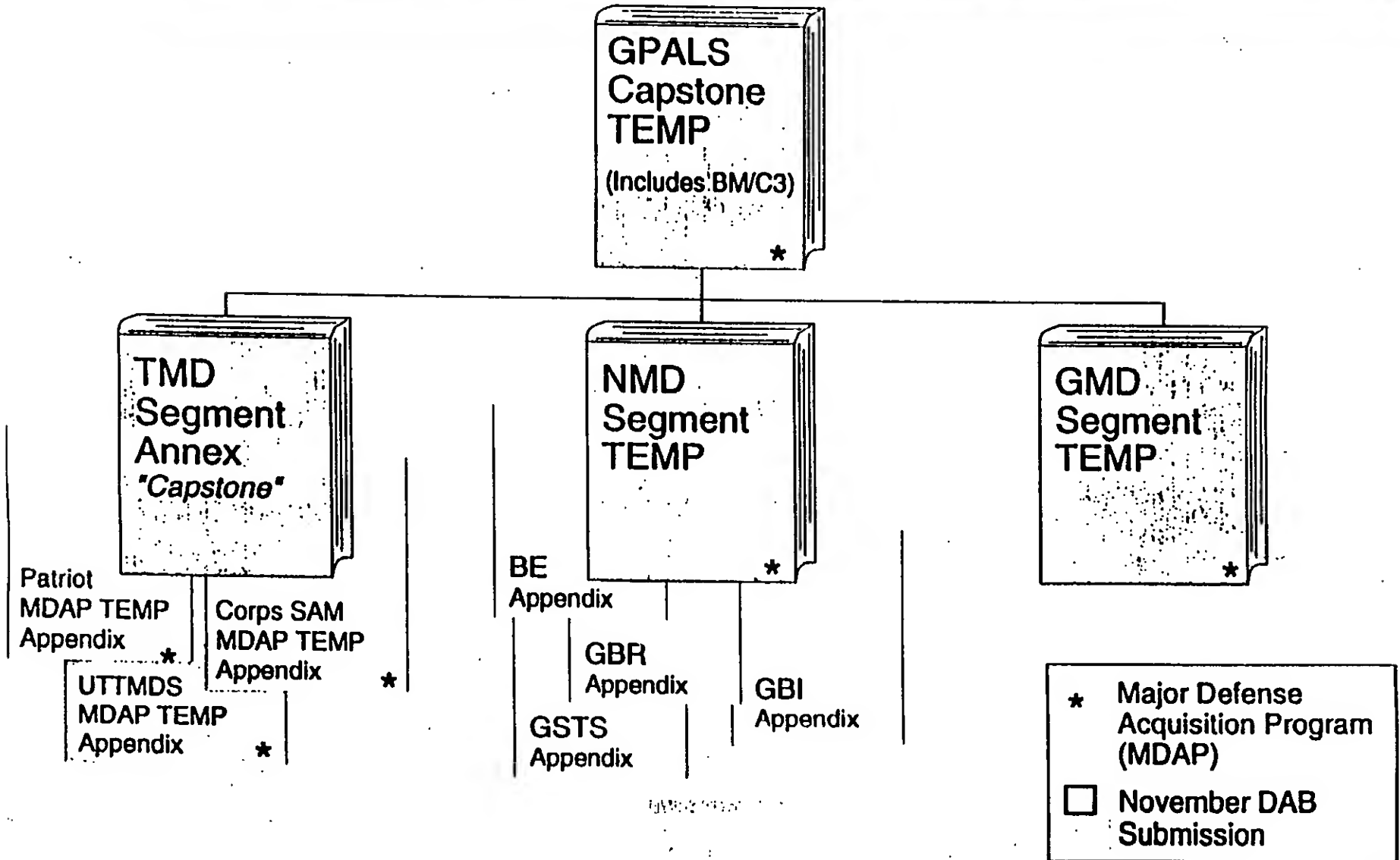
- EXPAND FLIGHT ENVELOPE
- DEMONSTRATE O&S GOALS
  - 3 DAYS TURNAROUND
  - RESPONSIVE CALL-UP

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PHASE II 5

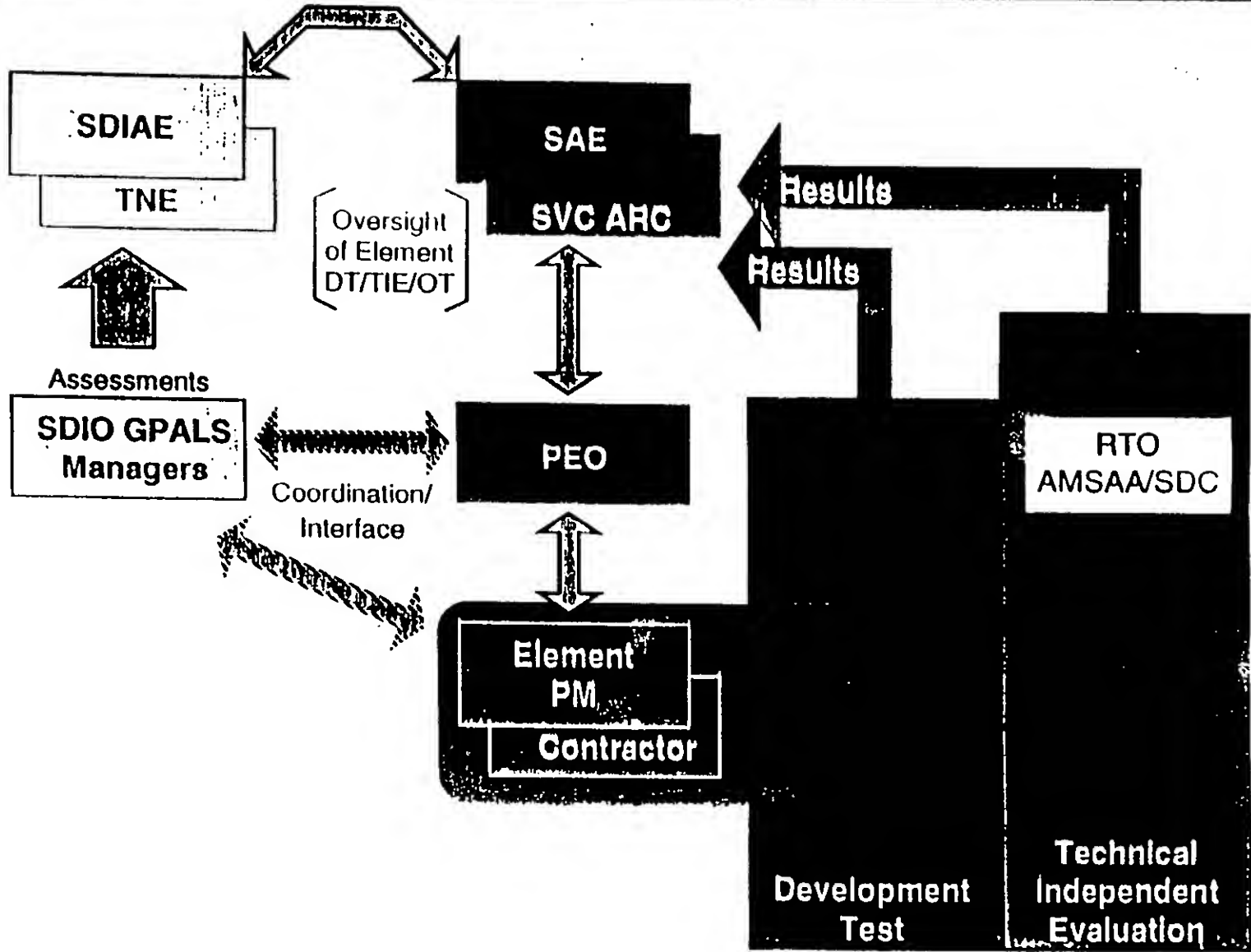


# TEMP Structure



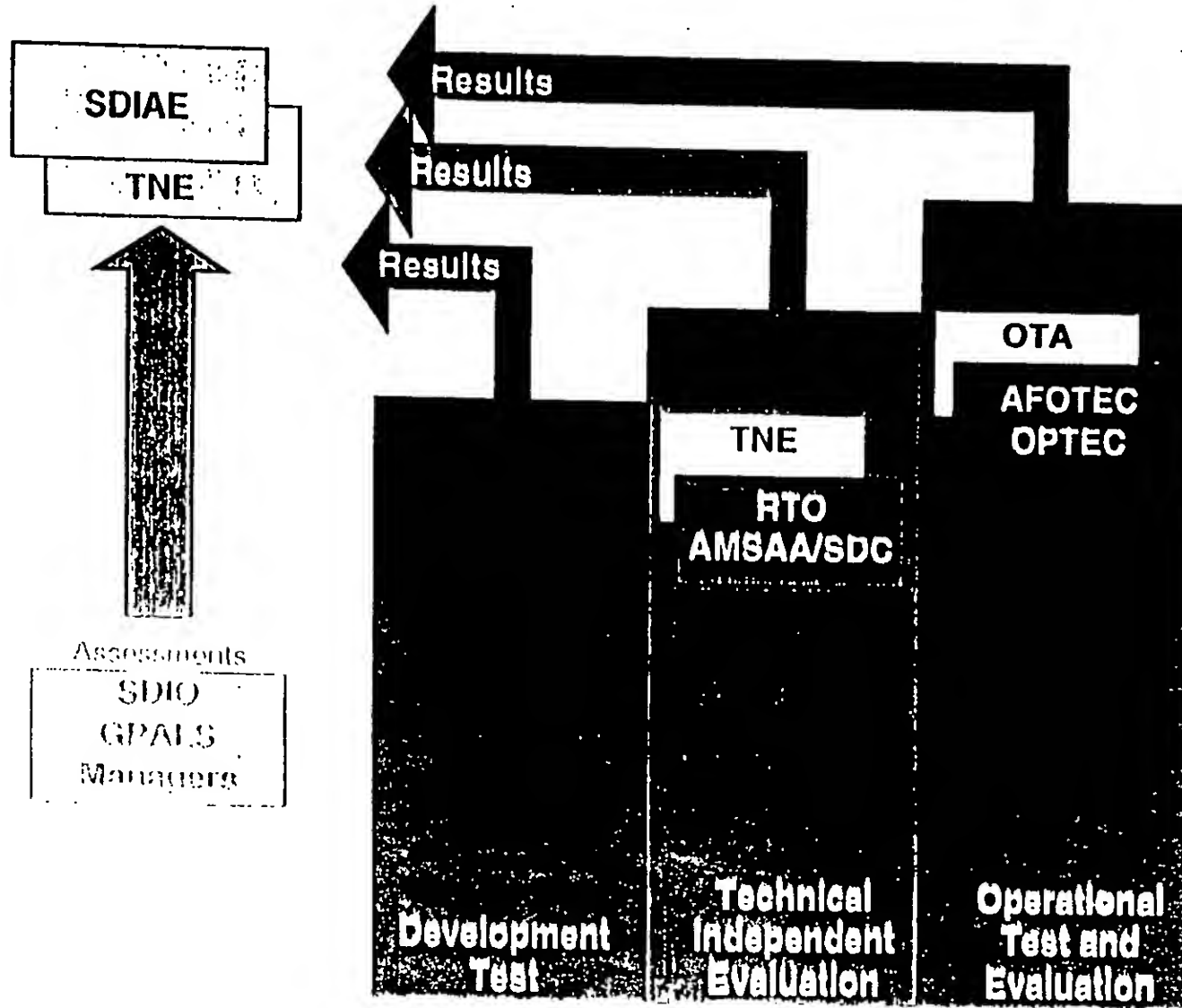


# Element T&E





# System / MDAP T&E





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# OUTLINE

---

- The Goal**
- Lessons Learned**
- The Military Construction Process**
- NMD Facility Acquisition Timelines**
- Summary**

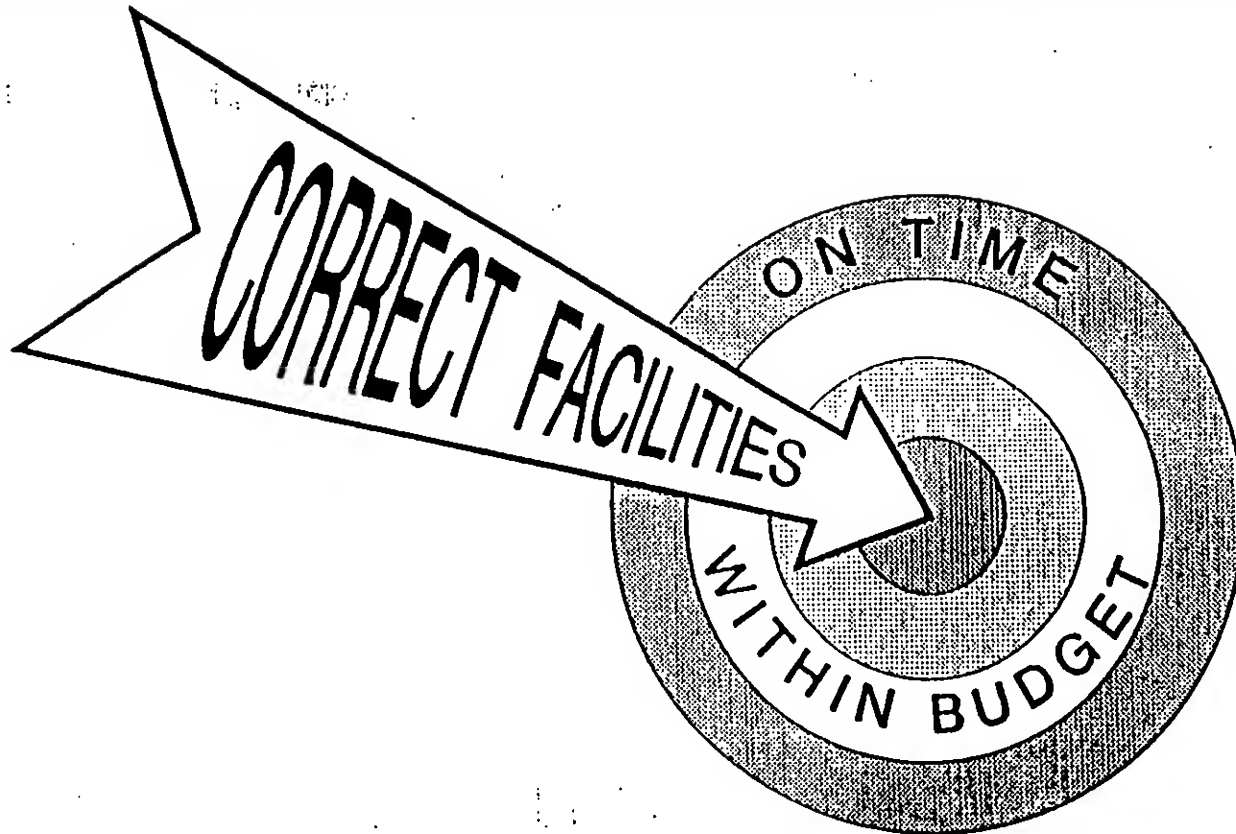
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# THE GOAL

---



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# LESSONS LEARNED

---

- Establish Clear Lines of Authority and Responsibility**  
Fast Track Decisions
- Maintain Strong Executive Agent Control**  
Identify Requirements Upfront  
Specify Realistic Facility Standards  
Actively Direct the Configuration Change Order Process  
Ensure System & Facility Contractor Communications
- Make Civil Engineering Part of the "Acquisition Team"**  
A/E Designer and Element System Contractor Partnership  
Get User Involved Early and Keep Him Involved
- Keep NEPA Requirements and Timeliness Upfront**

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# THE MILITARY CONSTRUCTION PROCESS

PLANNING DESIGN BUDGET PROGRAM  
YEAR YEAR YEAR YEAR

	FY 1	FY 2	FY 3	FY 4	FY 5
<b>Planning</b>					
<b>Programming</b>					
<b>Design</b>					
<b>Construction</b>					
	<b>Const. Complete</b>				

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# THE RDT&E CONSTRUCTION PROCESS

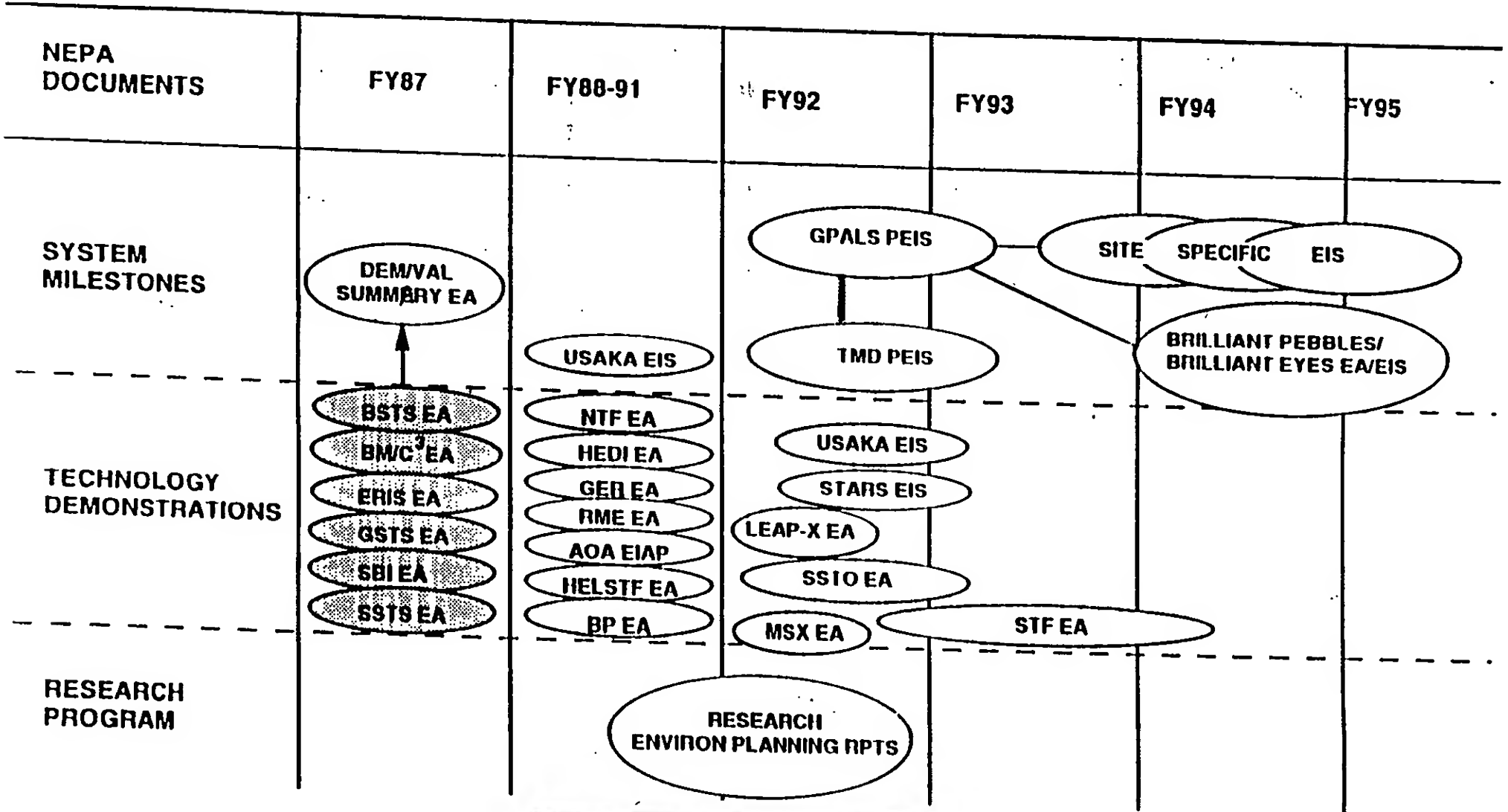
BUDGET PROGRAM  
YEAR YEAR

	FY 1	FY 2	FY 3	FY 4	FY 5
<b>Planning</b>					
<b>Programming</b>					
<b>Design</b>					
<b>Construction</b>					

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# SDIO NEPA COMPLIANCE STRATEGY



**LEGEND**

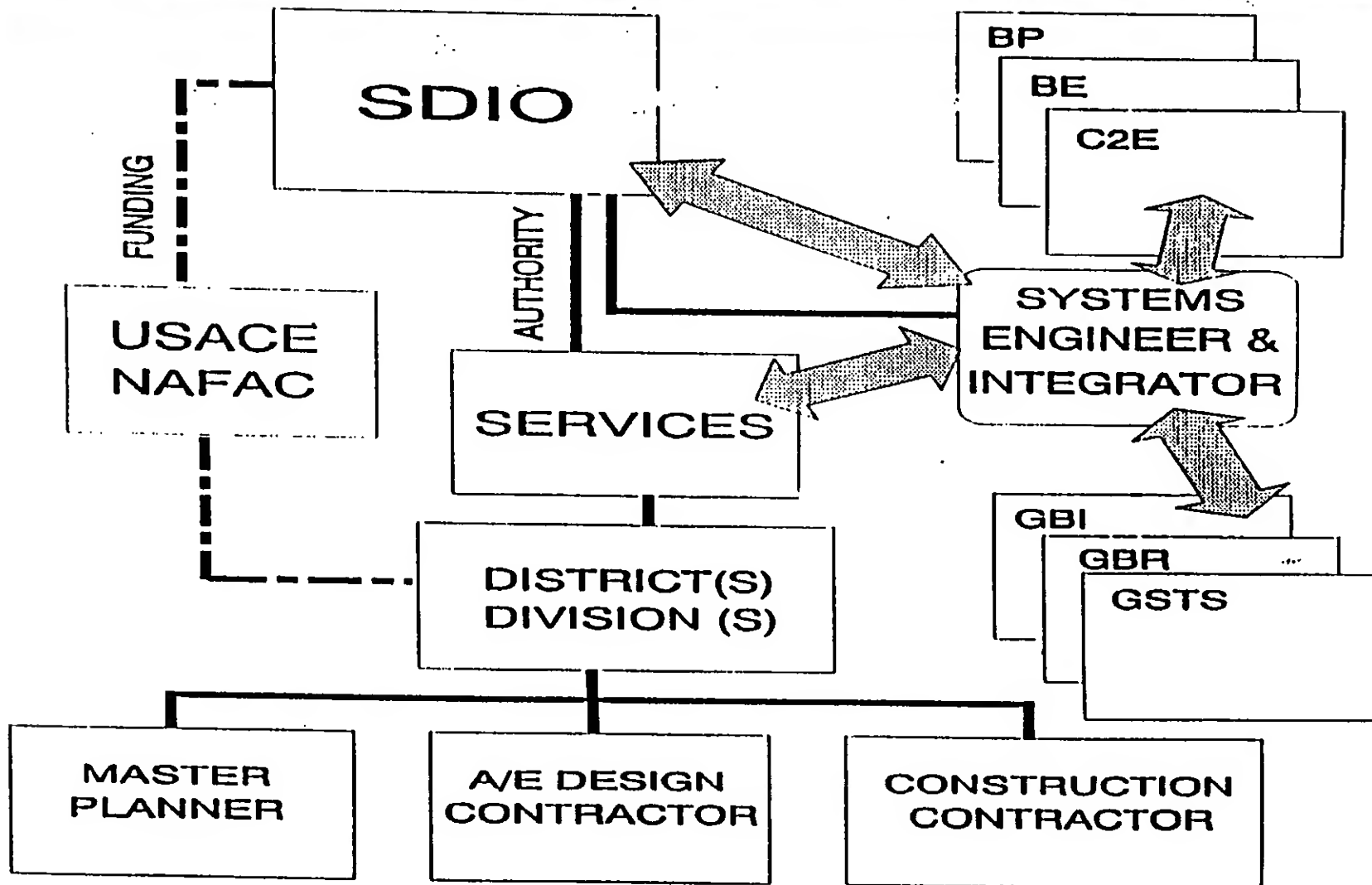
————— Tiered Document

..... Reference Document



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# IMPACT OF SYSTEMS ACQUISITION THE MILITARY CONSTRUCTION PROCESS



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# THE MILITARY CONSTRUCTION PROCESS

## ROLES AND RESPONSIBILITIES

---

**Congress**

**Provides Funds**

**SDIO (Executive Agent)**

**Executes PPBS Process**

**Ensures NEPA Compliance**

**Issues Authority & Funding to Executing Agents**

**Provides Congressional Interface**

**Directs SE & I Process**

**Provides Executive Oversight**

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WMD/PAISACD 26/12/01



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# THE MILITARY CONSTRUCTION PROCESS

## ROLES AND RESPONSIBILITIES (CON'T)

---

**Services (Executing Agent)**

**Establishes Site Specific Facilities Requirements**

**Assigned as Design/Construction Manager**

**Executes the Site Specific NEPA Process**

**Design/Construction Agent (USACOE, NAVFAC)**

**Executes Design/Construction Activity**

**Oversees Design/Construction Contractors**

**Installation Commander/System User**

**Establishes User Requirements**

**Accepts, Operates and Maintains Facilities and Systems**

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NWD/DPALSACQ 28/12/01



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# THE MILITARY CONSTRUCTION PROCESS

## ROLES AND RESPONSIBILITIES (CON'T)

---

- Services (Executing Agent)**
  - Establishes Site Specific Facilities Requirements
  - Assigned as Design/Construction Manager
  - Executes the Site Specific NEPA Process
- Design/Construction Agent (USACOE, NAVFAC)**
  - Executes Design/Construction Activity
  - Oversees Design/Construction Contractors
- Installation Commander/System User**
  - Establishes User Requirements
  - Accepts, Operates and Maintains Facilities and Systems

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# STRATEGIC DEFENSE INITIATIVE

## Strategic Defense In 'The 1990's



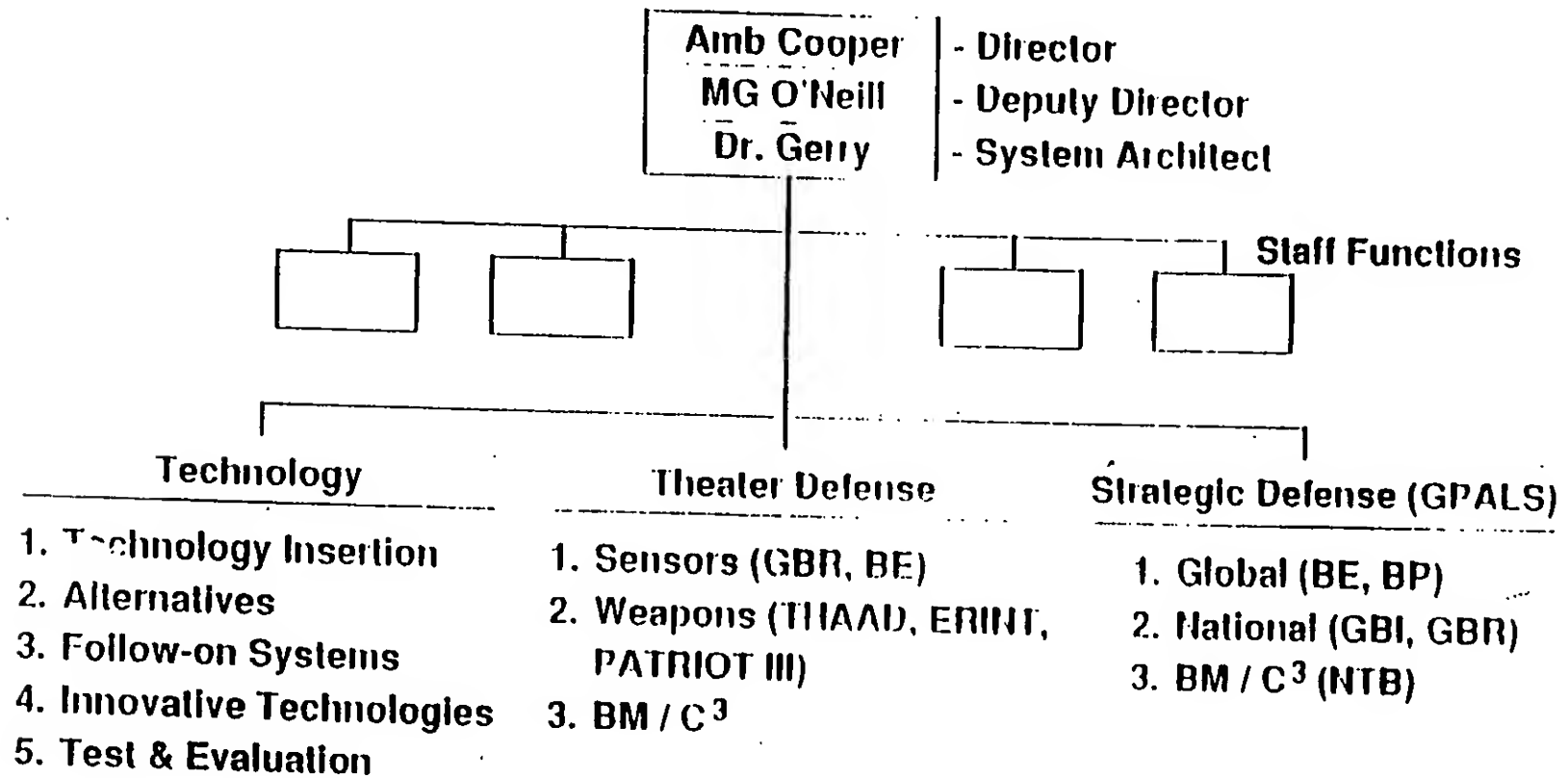
**Col Simon P. (Pete) Worden, USAF**  
**Deputy For Technology**  
**Strategic Defense Initiative Organization**





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# SDIO TODAY



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**TEST AND EVALUATION**

**INTERCEPTOR  
TECHNOLOGY**

**SENSOR TECHNOLOGY**

# **TECHNOLOGY OVERVIEW**

**KEY TECHNOLOGY**

**DIRECTED ENERGY**

**INNOVATIVE SCIENCE  
& TECHNOLOGY**



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# TECHNOLOGY FASTER, CHEAPER AND BETTER

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PL 21511 / 012102



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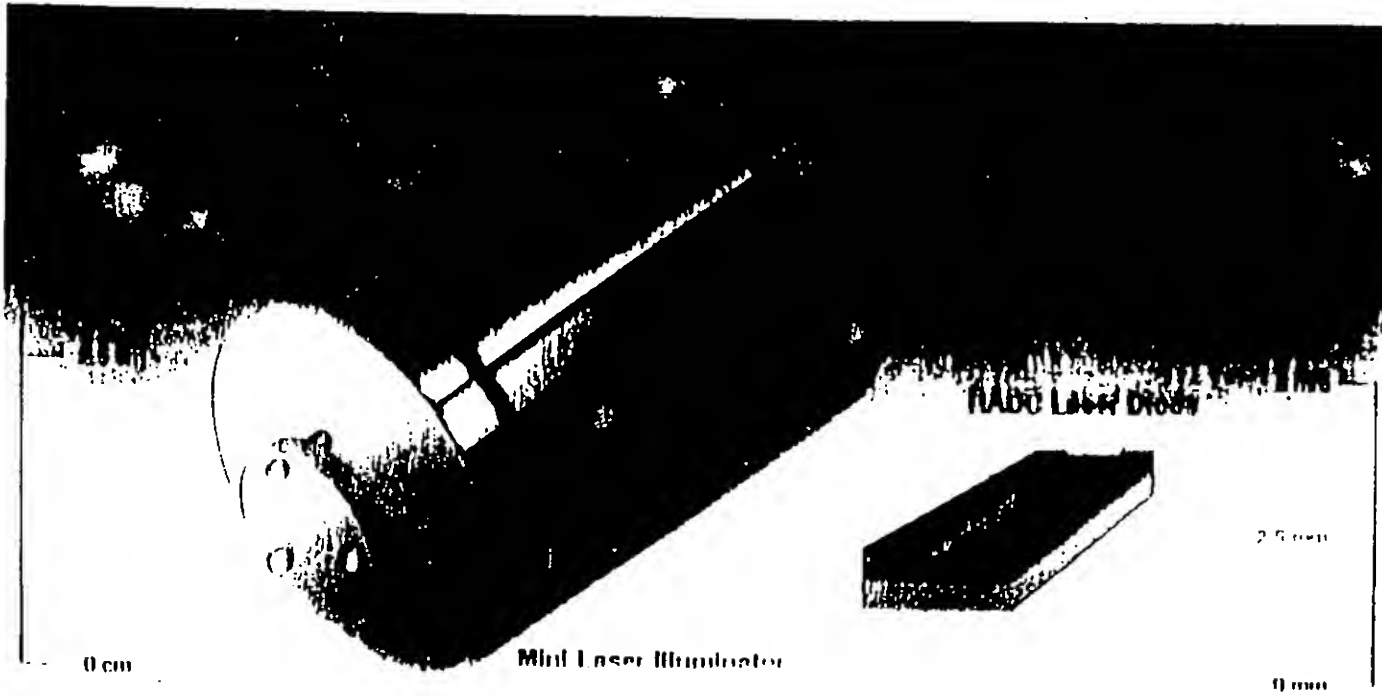
# TECHNOLOGY INSERTION

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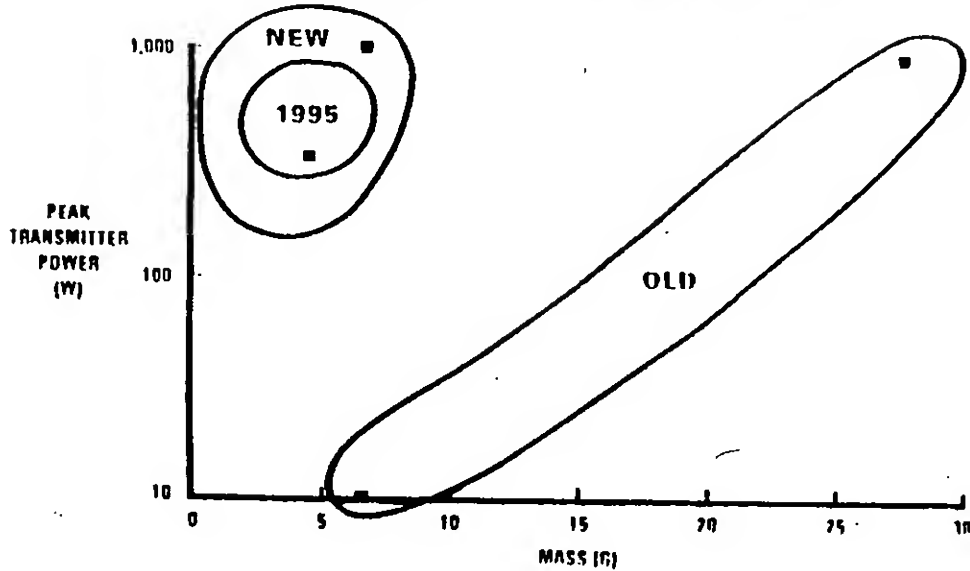
In 23545 / 012192



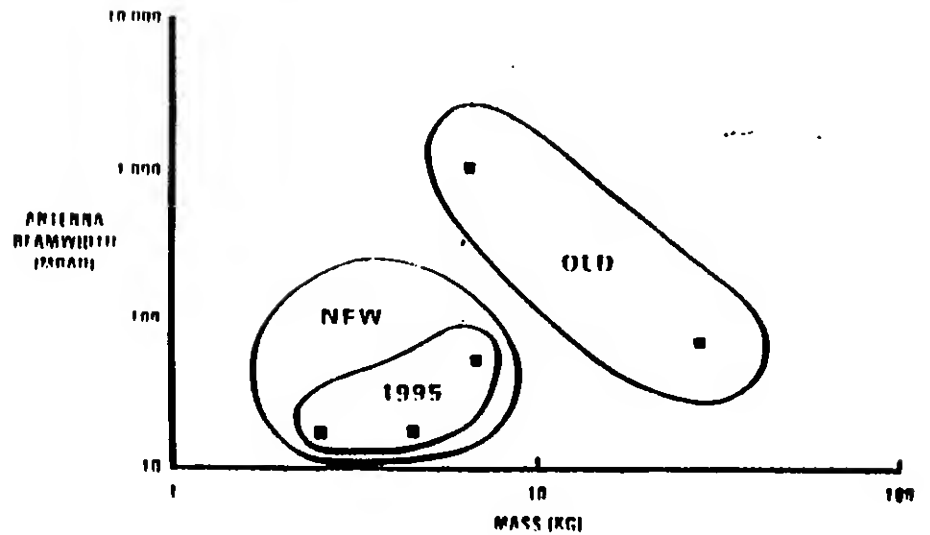
# ACTIVE SEEKERS COMPONENTS



RF TRANSMITTER PEAK POWER VS. MASS



RADAR ANTENNA BEAMWIDTH VS. MASS



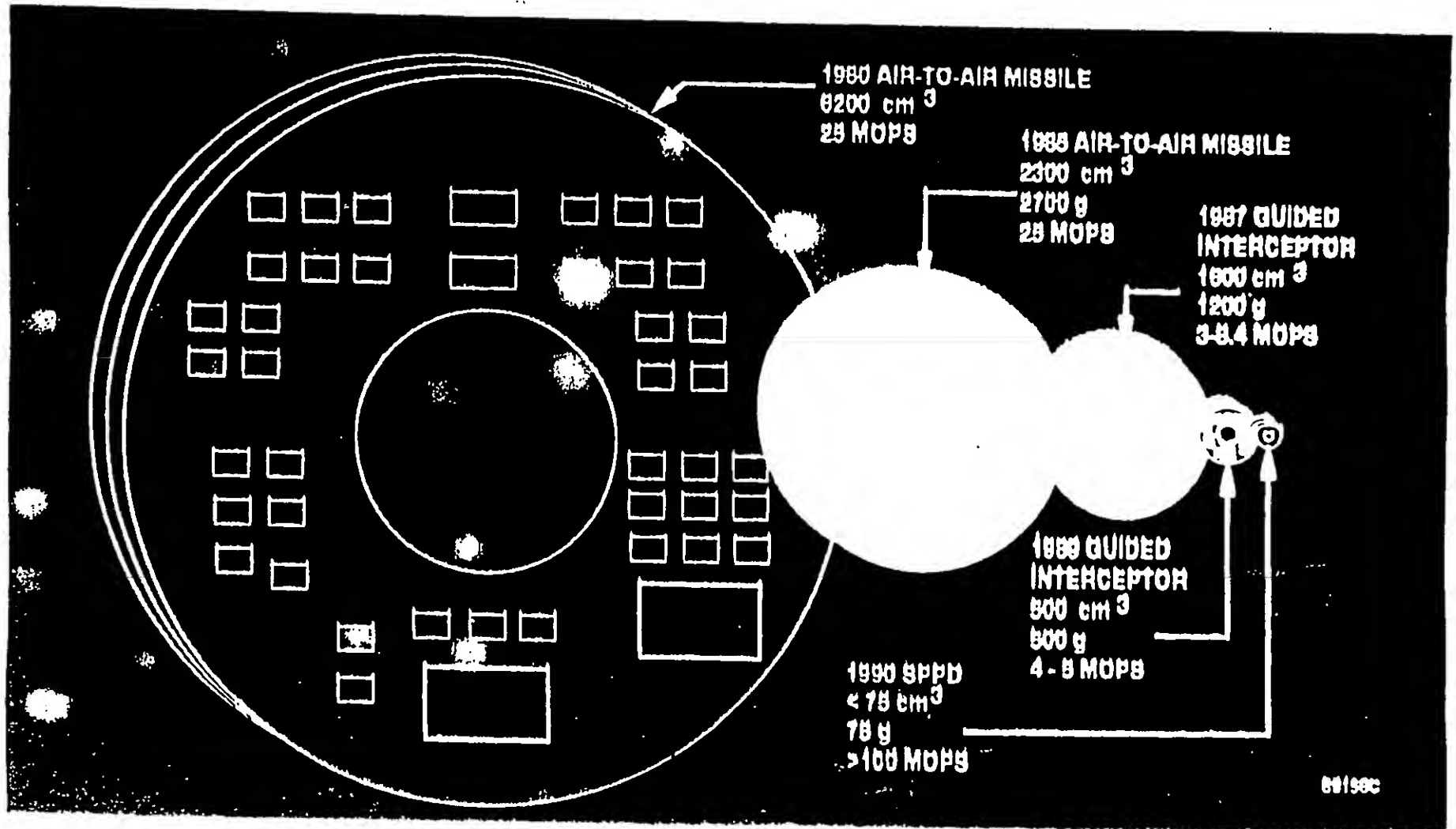
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STRATEGIC AND TECHNICAL INSTITUTE  
DEPARTMENT OF DEFENSE



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# SIGNAL PROCESSOR VOLUME IS A KEY DRIVER OF INTERCEPTOR



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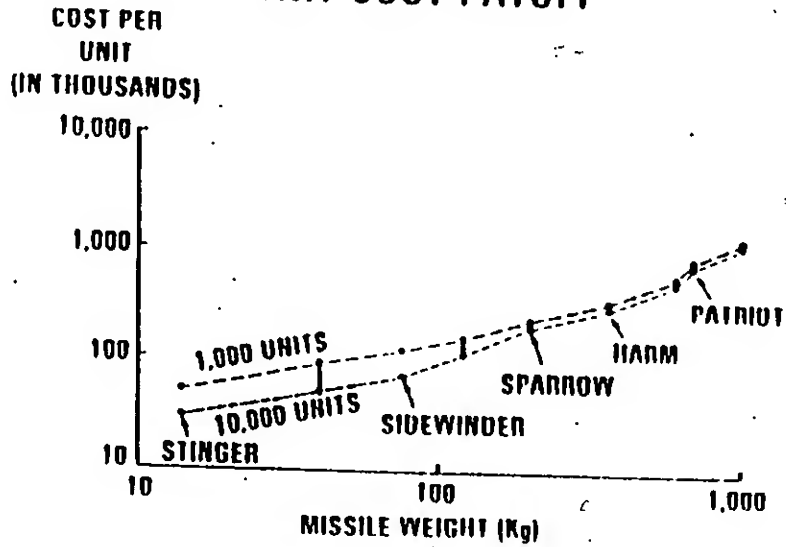
311 7114  
29 10-91



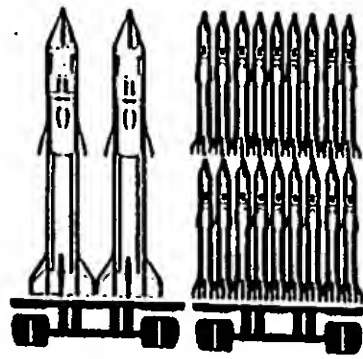
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# BOTTOM LINE ON SIZE AND COST

## UNIT COST PAYOFF



## THAAD MOBILITY LOGISTICS PAYOFF

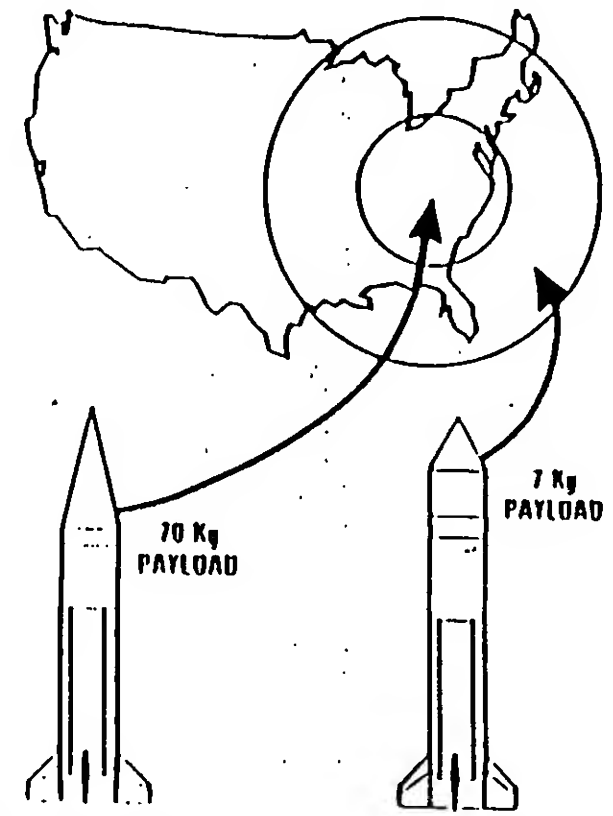


1991

1996

8 TIMES LOADOUT FOR SMALL INTERCEPTORS

## GBW PERFORMANCE LOGISTICS PAYOFF



70 Kg PAYLOAD

7 Kg PAYLOAD

VELOCITY = 5 Km/sec

VELOCITY = 7.2 Km/sec

1991

1996

ONE-TENTH SIZE YIELDS 4 TIMES PROTECTED AREA

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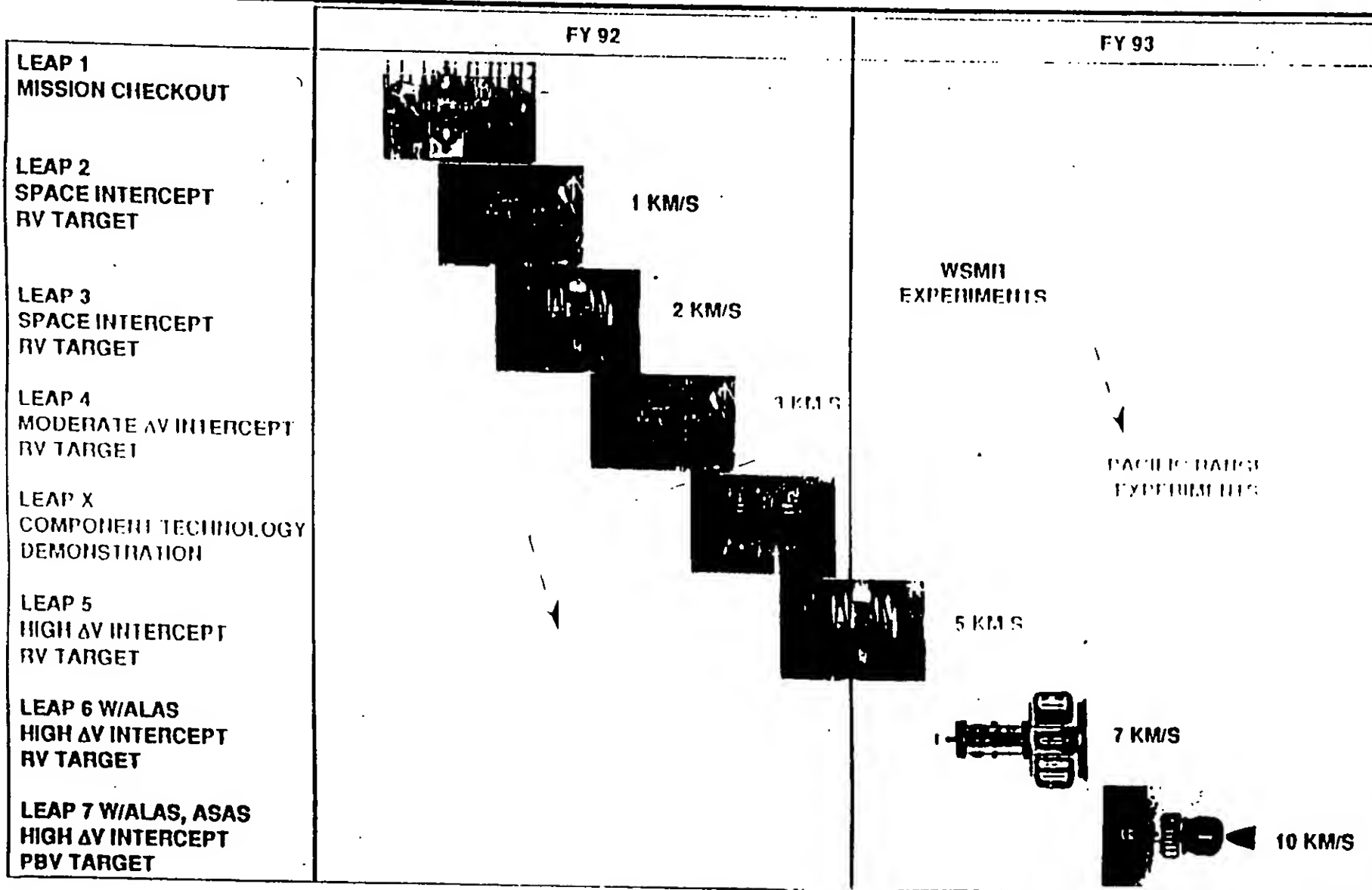
DDI FORM 1  
1-85



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# LEAP FLIGHT TEST SCHEDULE



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# ALTERNATIVES

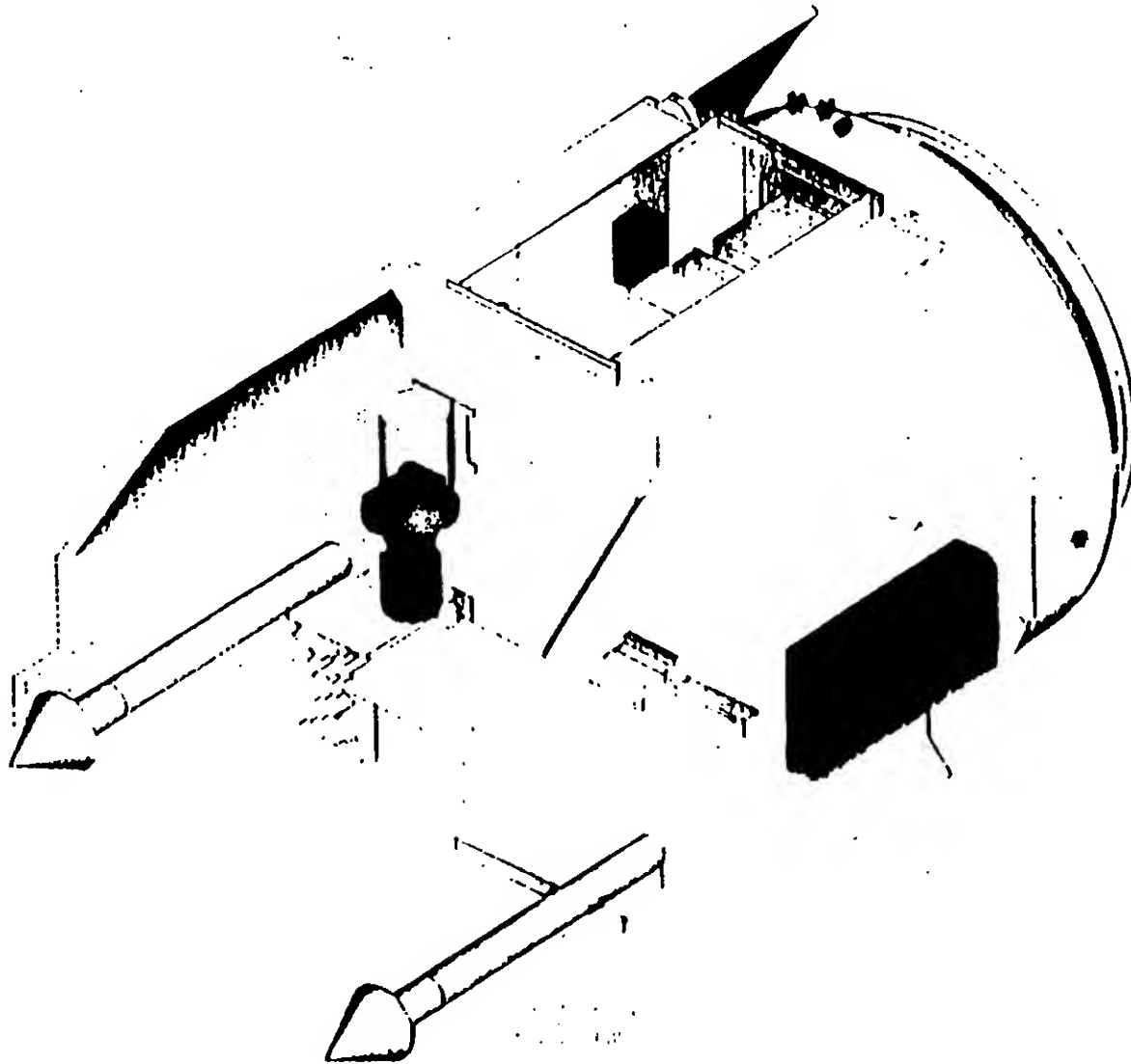
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DD FORM 101-102



UNCLAS

# MSTI SATELLITE MULTIMISSION BUS CONCEPT

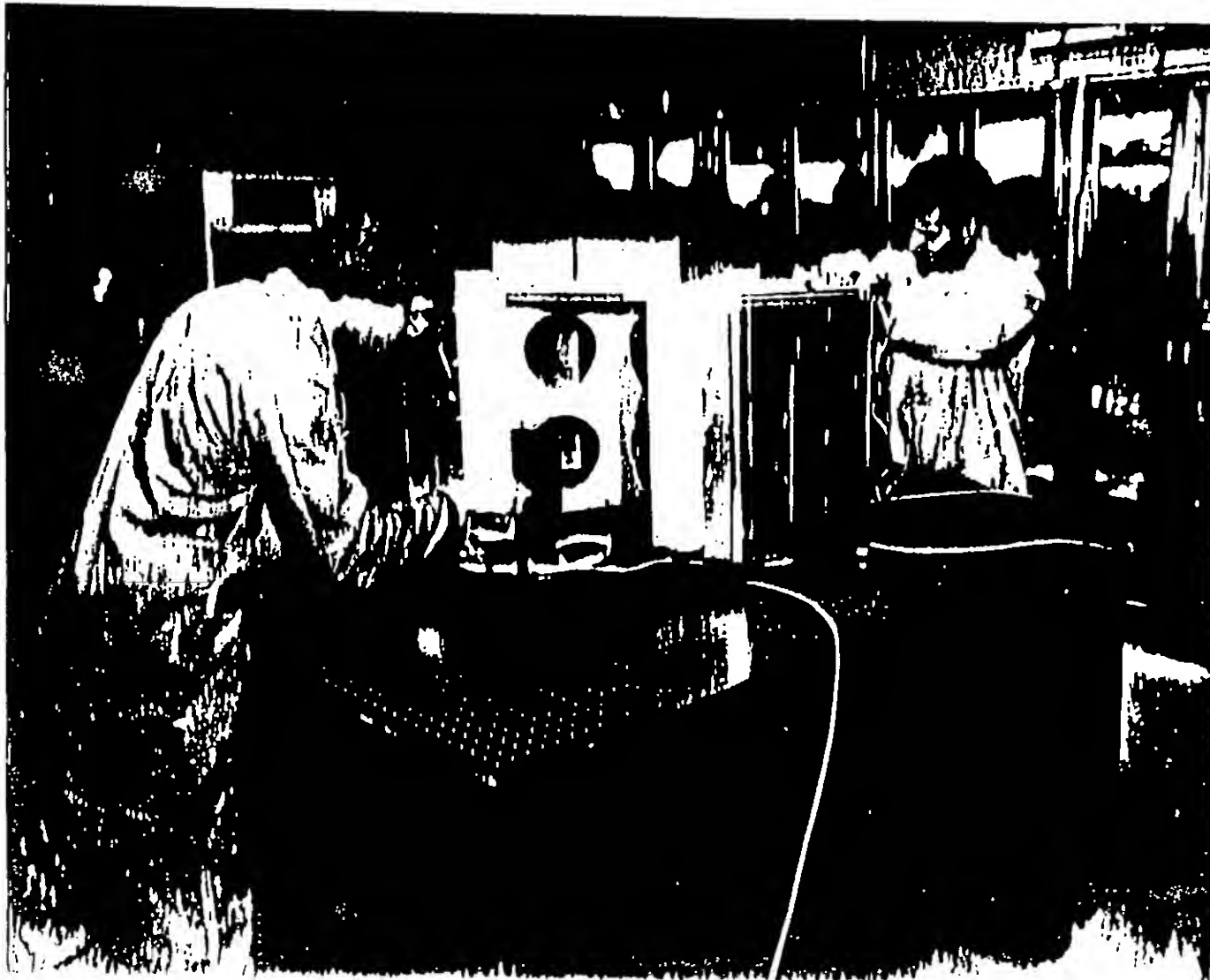


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913 1004  
11 Dec 91



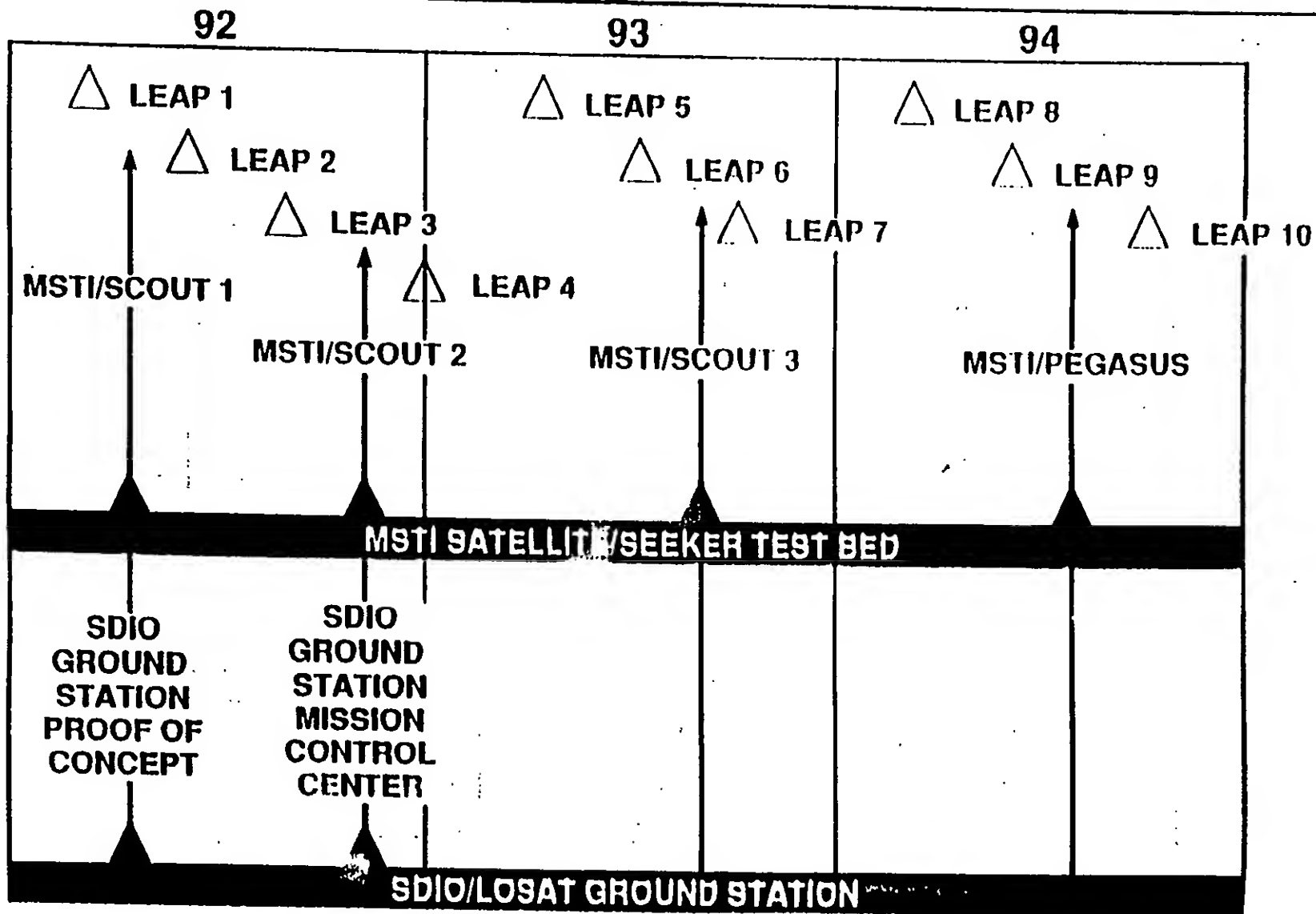
UNCLASSIFIED  
MSTI SATELLITE INTEGRATION AT  
PHILLIPS LAB  
EDWARDS AFB





UNCLASSIFIED

# MSTI DEPLOYMENT AND LEAP FLIGHT TESTS



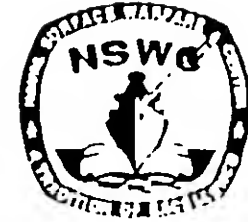
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921 000  
21 10100

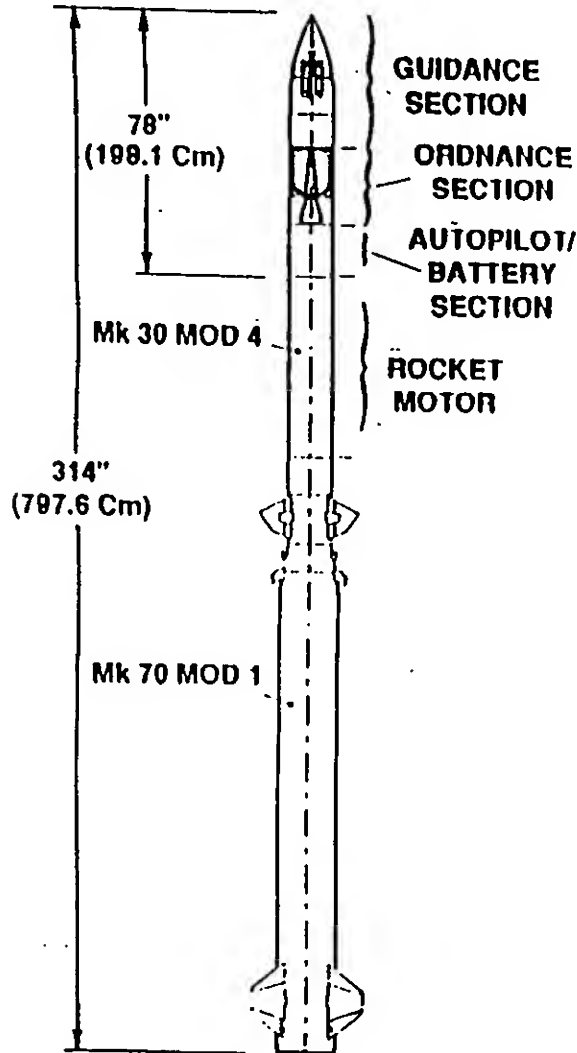


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# LEAP LAUNCH VEHICLE PERFORMANCE USING SM 2 BLOCK II ER (TERRIER) BOOSTER AND SUSTAINER PLUS ASAS



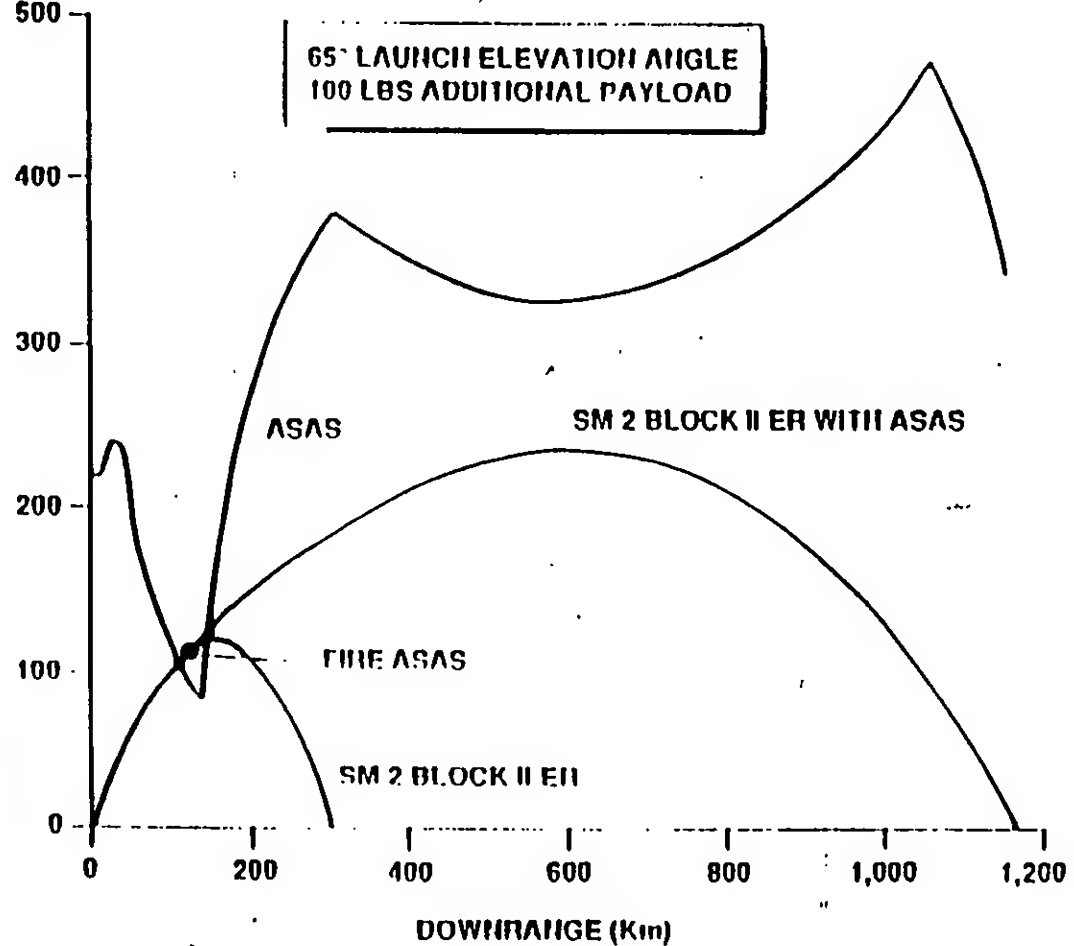
WEIGHT: 3,383 LB  
(1,522 Kg)    13.5" (34.3 Cm)



VELOCITY  
(Kps)

ALTITUDE  
(Km)

3.5  
3.0  
2.5  
2.0  
1.5  
1.0  
0.5  
0



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910-10177  
07Sep 81



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# NAVY LEAP GETS YOU . . .



FLIGHT	1	2	3	4	5	6	7	8	9
DATE	FEB 92	MAY 92	SEP 92	DEC 92	FEB 93	MAR 93	JUL 93	SEP 93	DEC 93
RANGE	ATWIT	WSMR OR, ATWIT, OR PACIFIC RANGE							
INTERCEPTOR LAUNCH MODE	SHIPBOARD RAIL	DESERT SHIP RAIL			WSMR YES/RAIL	SHIPBOARD YES/RAIL	SHIPBOARD YES/RAIL		
RICK MOTOR	NONE	WASS MDCRUP	ADVANCED SOLID		AVALANCE (MQR)				
SUSTAINER	MR 30 MOD 7				MR 30: MR 104				
BOOSTER	SM2 BLOCK IIA		SM2 BLOCK IIA			SM2 BLOCK IIA		SM2 BLOCK IV	
INTERCEPTOR	WASS MDCRUP	LEAP 1 OR		LEAP 2 OR		LEAP 3			
FIRE CONTROL ELEMENTS	TIMING	TIMING	TIMING	RADAR TRACK AND ALERT	SHIPBOARD AICIS (MQR) TERRIER		TERRIER		
CLOSING VELOCITY	22 KM/S	22 KM/S	17 KM/S	7 KM/S	2200 KM/S	1.0 KM/S	0.0 KM/S	5.000 S	0.1 KM/S

- 9 FLIGHT TESTS
- 5 AT SEA DEMO
- EARLY SHIPBOARD DEMONSTRATION
- PROVIDES AGGRESSIVE PRE-THREAT TMD ROLE
- MERGES SDIO/NAVY TEST AND TECHNOLOGY INFRASTRUCTURES
- BRINGS NAVY TO TECHNOLOGY READINESS

**NAVY LEAP WILL HAVE DEMONSTRATED EXO-TMD CAPABILITY BY 1993**

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# AIRBORNE LASER

UNCLASSIFIED

FD-23547 / 012102



# INITIAL OBSERVATIONS

---

- **BOOST PHASE INTERCEPT WOULD BE A COMPELLING ADDITION TO THEATER MISSILE DEFENSE**
- **AIRCRAFT-BASED LASERS (ABL) OFFER PROMISE IN PROVIDING SUCH A CAPABILITY**
- **ABL IS NOT A NEW CONCEPT; A 10<sup>14</sup> W/sr CLASS LASER SHOT DOWN AIR-TO-AIR MISSILES IN 1983-84**
- **THE TECHNOLOGY BASE CREATED IN OVER TWO DECADES OF WORK SUPPORTS THE CONCEPT**
- **FOCUSED PROGRAM COULD YIELD OPERATIONAL CAPABILITY EARLY IN THE NEXT DECADE**





# Airborne Laser Laboratory (ALL)

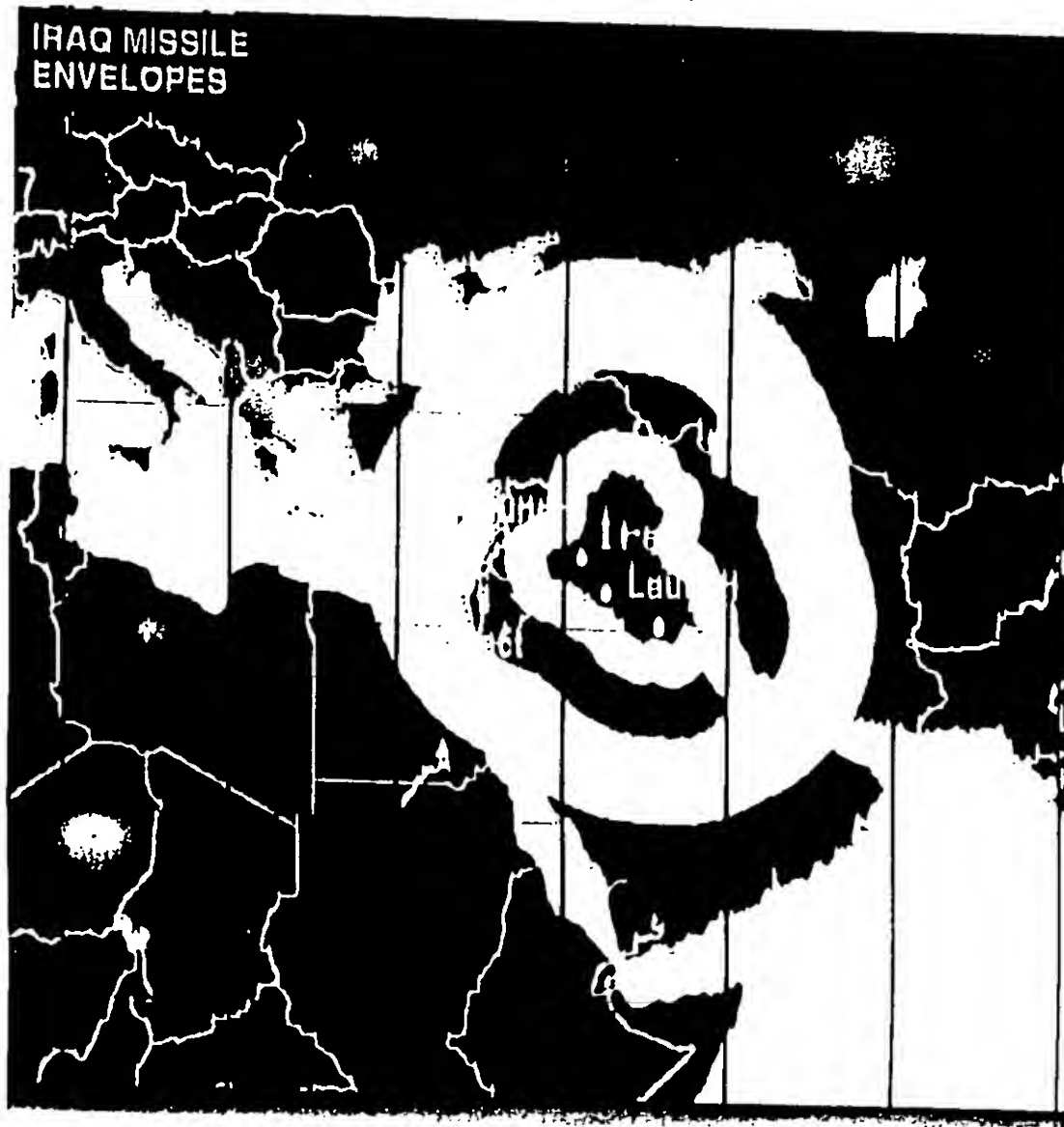


- Demonstrator program: 1970 to 1983
- Laser- High Energy CO<sub>2</sub> GDL (10.6  $\mu$ m)
- 60 cm Pointer telescope
- Demonstrated
  - 6  $\mu$ rad class tracking (1 sigma - 1 axis)
  - Destroyed 5 Air to Air missiles (AIM-9)
  - Destroyed 2 Cruise missiles (BQM-34)



# IRAQ "SCENARIO SUMMARY"

- OPTIMIZED THREAT BASING ASSUMED FOR MAXIMUM OFFENSE CAPABILITY



## Threat Class

- I ■ 200 km Range
- II ■ 500 km Range
- III ■ 1000 km Range
- IV ■ 3000 km Range



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# FOLLOW-ON

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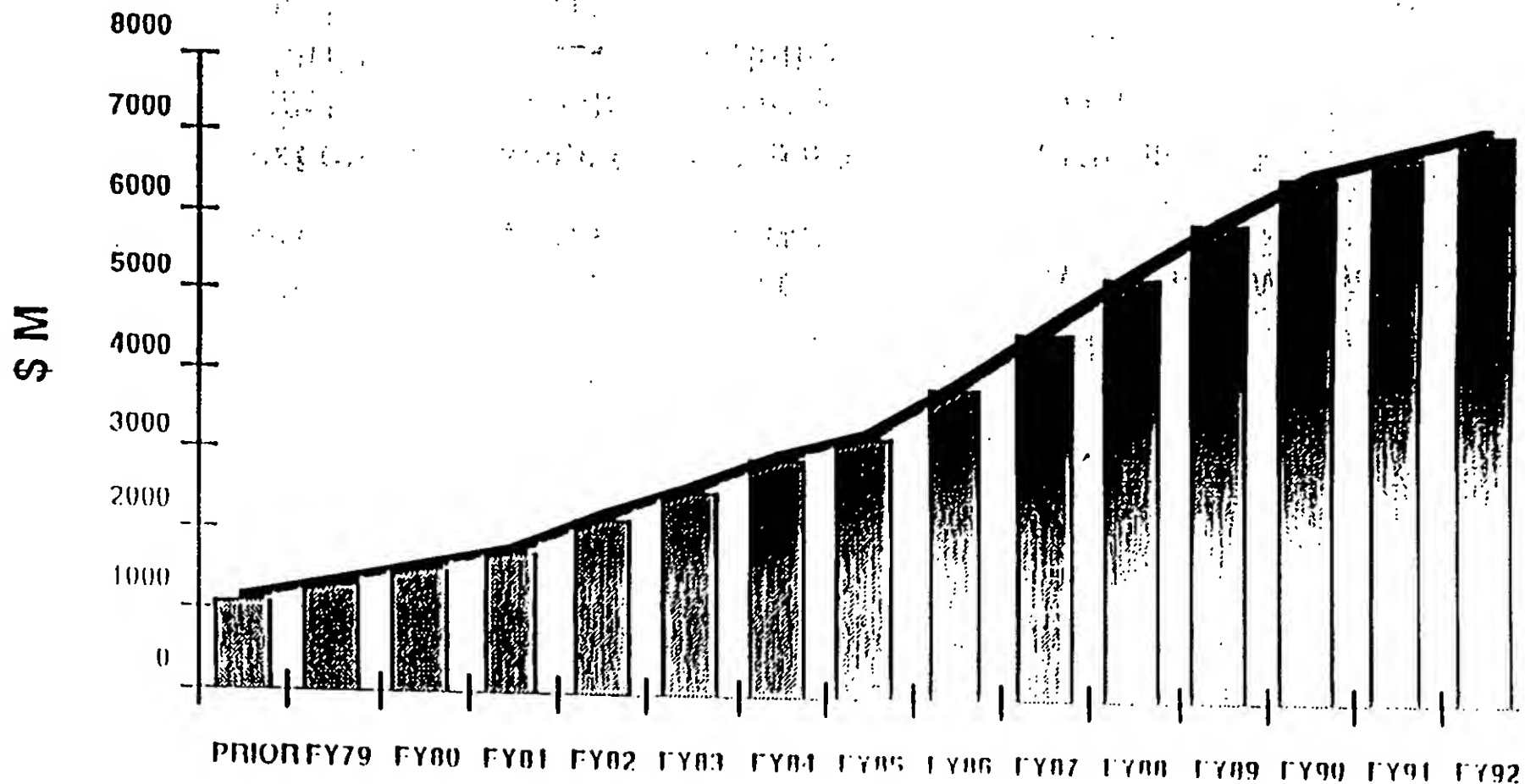
## STARWARS - THE DREAM IS ALIVE AND WELL!

---

- DoD Has Made Considerable Investments In Directed Energy (Speed-Of-Light) Weapons Technology For Two Decades
- Pay-Offs Are Emerging Now
  - Near Weapon Level Components Have Been Built And Tested, And Are Now Being Integrated For Mid-90s Tests
- In The Next Decade, This Nation Can Field Truly Unique Weapon Systems For A Broad Variety Of Defense Missions, e.g.
  - Boost-Phase Intercept Of Strategic And Theater Missiles
  - Interactive Discrimination Of Decoys From Warheads
  - Worldwide Full-Time Air Superiority
  - Highly Robust Surveillance

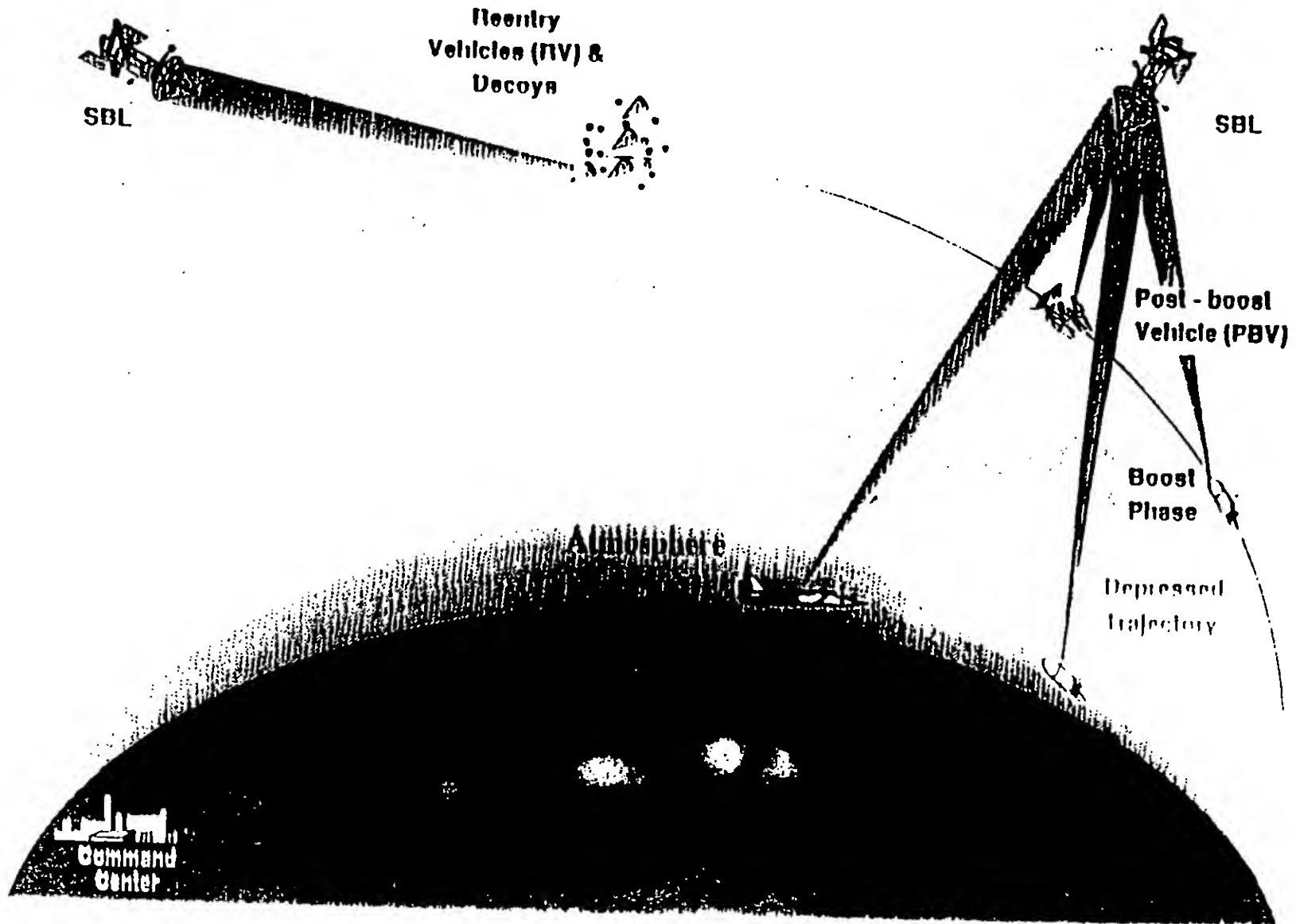


# DIRECTED ENERGY INVESTMENT THEN YEAR DOLLARS



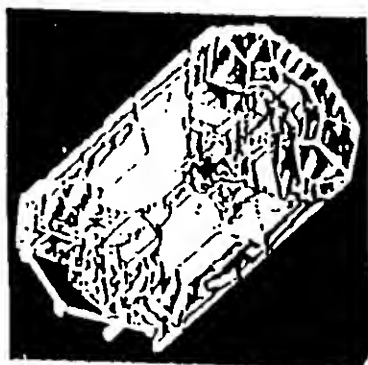


# SPACE BASED CHEMICAL LASER

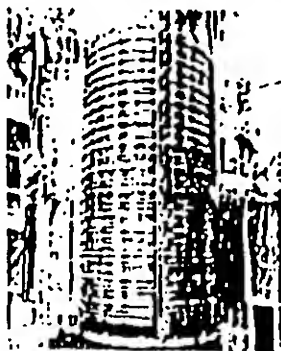




# LASER DEVICE TECHNOLOGY



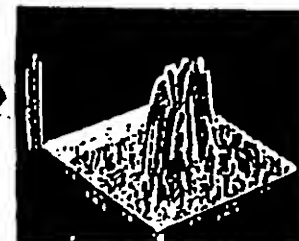
Alpha Laser



Gain Generator Assembly



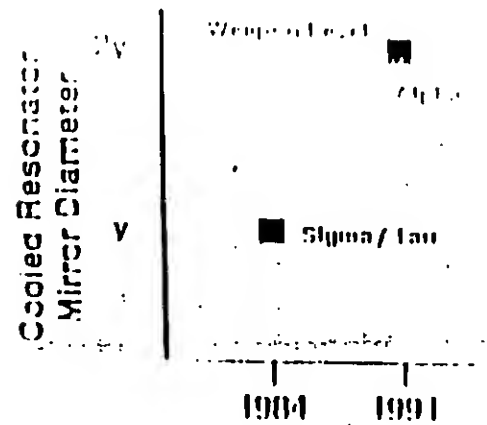
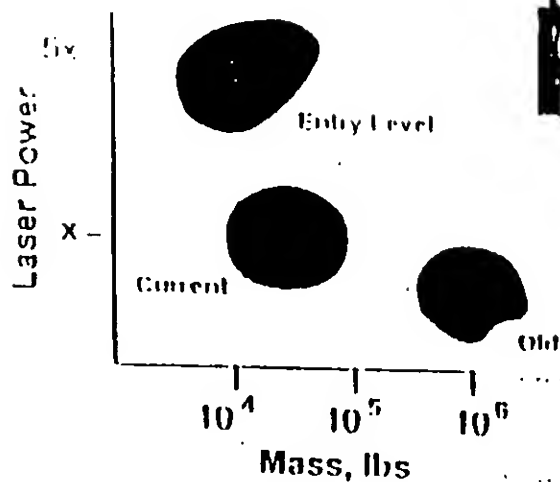
Test Facility



Alpha Hear Field Irradiance

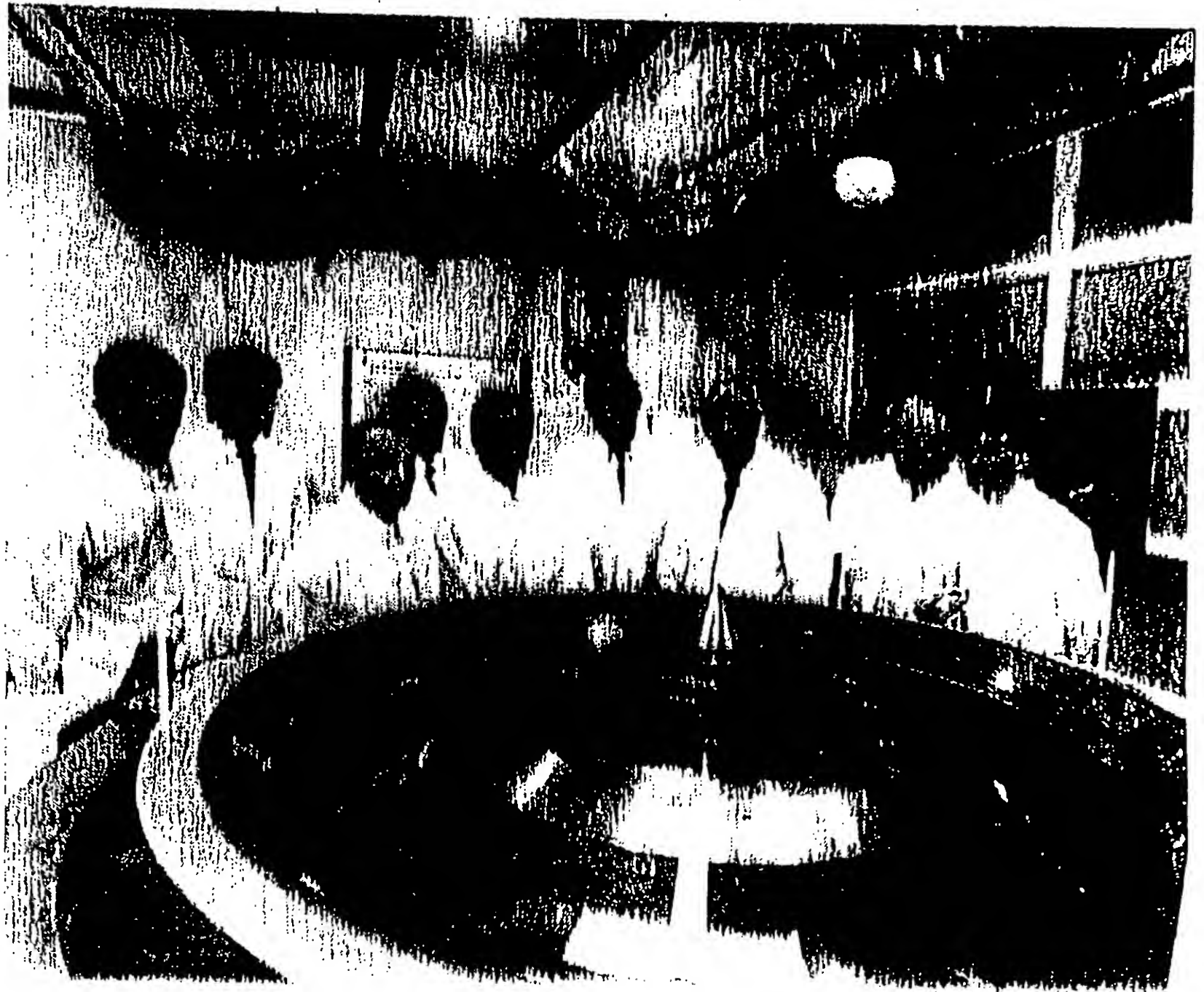


Optics











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# INNOVATIVE TECHNOLOGY

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## MISSION ISSUE

---

*Create New Materials To Improve The Performance, Survivability  
And Miniaturization Of SDI Systems*

### *Technical Goal*

- Thrust The U.S. Into A New "Age" Of Diamond For Windows, Coatings, And Electronics

### *Payoff*

- Integrated Circuits With Higher Density, Higher Temperature And Faster Speed
- Thin Rocket Windows To Withstand High Speeds
- Diamond Hard Protective Coatings For *Everything*

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In 21550 / 012192



## DIAMOND PROPERTIES

PROPERTIES	DIAMOND	ALTERNATIVE MATERIAL
HARDNESS (kg/mm <sup>2</sup> )	9000	4500 (Boron Carbide)
THERMAL CONDUCTIVITY (W/m/K)	2000	130 (Silver)
OPTICAL TRANSMISSION (µm)	0.22 to > 100	0.2 to 4 (Silica)
COEFFICIENT OF FRICTION	0.05 - 0.1	0.1 (Teflon)
ELECTRICAL RESISTIVITY (Ωcm)	$1 \times 10^{16}$	$1 \times 10^{15}$ (Alumina)
THERMAL SHOCK (W/m)	10,900,000	10,600 (Zirconia)
TENSILE STRENGTH (kg/mm <sup>2</sup> )	230	35 (Alumina)



**IST**

# DIAMOND

---

## DIAMOND PROPERTIES

- HIGH THERMAL CONDUCTIVITY
- HIGH E BREAKDOWN STRENGTH
- RADIATION-HARD
- PHYSICALLY HARD
  
- HIGH-TEMPERATURE (REFRACTORY)
  
- HIGH DIELECTRIC STRENGTH

## APPLICATION

DENSE LOGIC CIRCUITS, HIGH-ENERGY LASER WINDOW COATINGS

U-WAVE & MILLIMETER WAVE POWER

SPACE ELECTRONICS

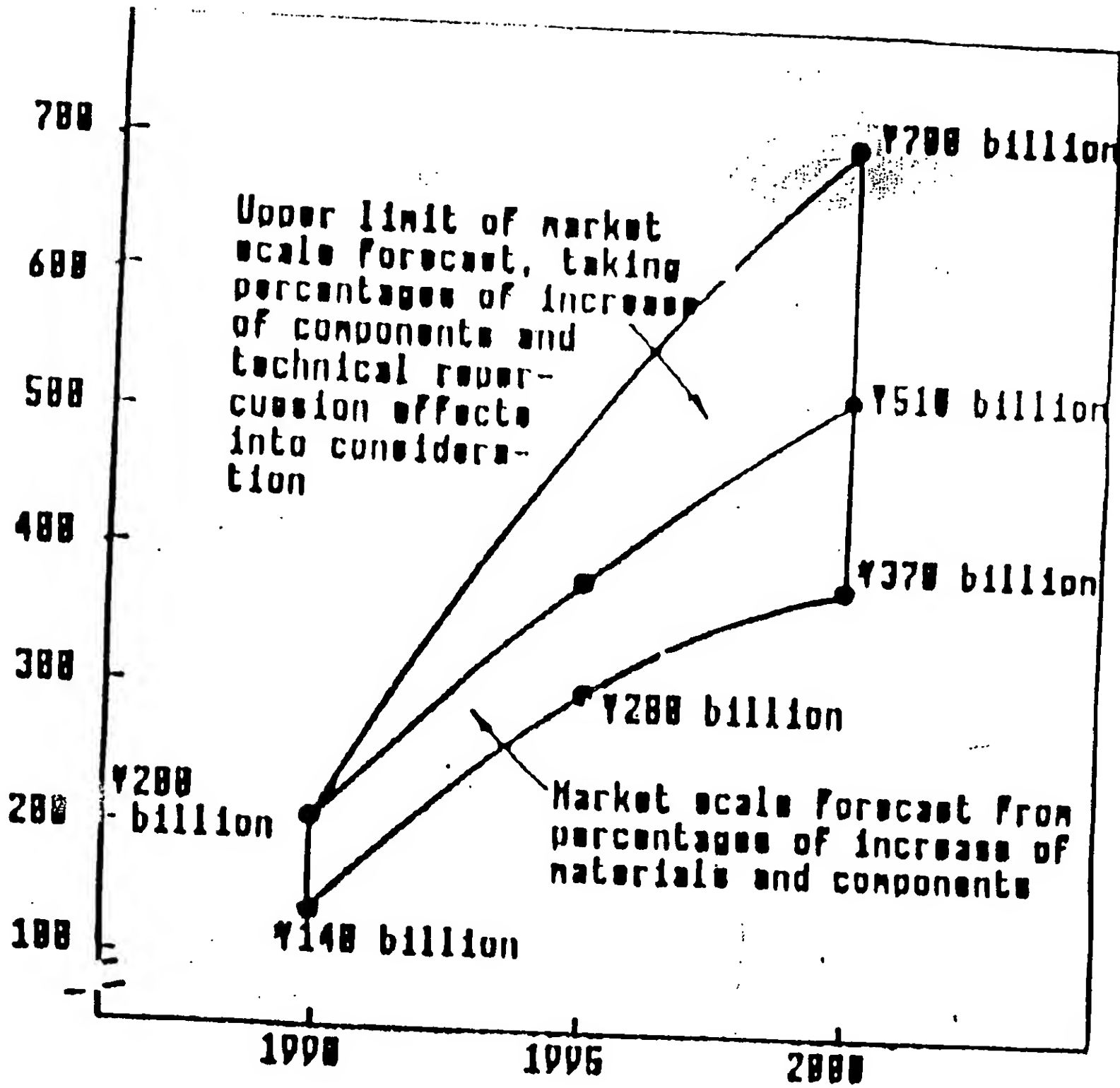
COATINGS: GLASSES, SURGICAL INSTRUMENTS, PROSTHESES, ...

COMPUTER DISCS, AUDIO SPEAKERS

SPACE ELECTRONICS, COMPUTERS, AUTO IGNITIONS & MONITORING

HIGH POWER CAPACITORS, ULTRA-FAST MICROELECTRONICS

Total sales of new diamond materials and components





# LAUNCH SERVICES





## OBJECTIVE

---



- CENTRALIZE THE ACQUISITION, MANAGEMENT, AND CONTROL OF LAUNCH REQUIREMENTS AND
  - REDUCE LAUNCH COST (MULTIPLE LAUNCH VS SINGLE LAUNCH PROCUREMENTS).
  - CREATE CENTER OF LAUNCH EXPERTISE.
  - MAXIMIZE THE BENEFITS OF LESSONS LEARNED
  - ELIMINATE DUPLICATION OF EFFORT
  - REMOVE LAUNCH VEHICLE / LAUNCH SERVICES RESPONSIBILITY FROM EXPERIMENTER/SCIENTIST





## CURRENT MANIFEST

### • BASIC CONTRACT FLIGHTS

LEAP 1  
LEAP 2  
LEAP 3  
LEAP 4  
PLACEHOLDER  
SPFE 6 (BP?)

### • SECOND CONTRACT OPTION FLIGHTS

LEAP X  
LEAP 5  
LEAP 6  
LEAP 7

### • FIRST CONTRACT OPTION FLIGHTS

ZEST 1  
ZEST 2  
SPFE DEMO (BP 1M)  
ASTRAL DANCER 1 & 2 (CANCELLED)

### • THIRD CONTRACT OPTION FLIGHTS

ENDO LEAP 1, 2, & 3  
PLACEHOLDER  
PLASMA RADIATION



**PHASE II DC-X  
TECHNOLOGY DEMO**



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## PROGRAM GOALS

---

- FLIGHT TEST OF REUSABLE SUBORBITAL ROCKET
- ENABLING TECHNOLOGY DEMONSTRATION
  - APPLICATION OF EXISTING TECHNOLOGY
  - SYSTEMS APPROACH TO LAUNCH
- DEVELOP AND DEMONSTRATE TECHNOLOGY BASE FOR DERIVED VEHICLES COST EFFECTIVE TO SDIO
  - CREATE DATABASE ENABLING A NEW CLASS OF SUBORBITAL TRANSPORTATION
  - ENABLE NATIONAL OPTION TO INVEST IN COST EFFECTIVE SSIO VEHICLE

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PHASE II 3

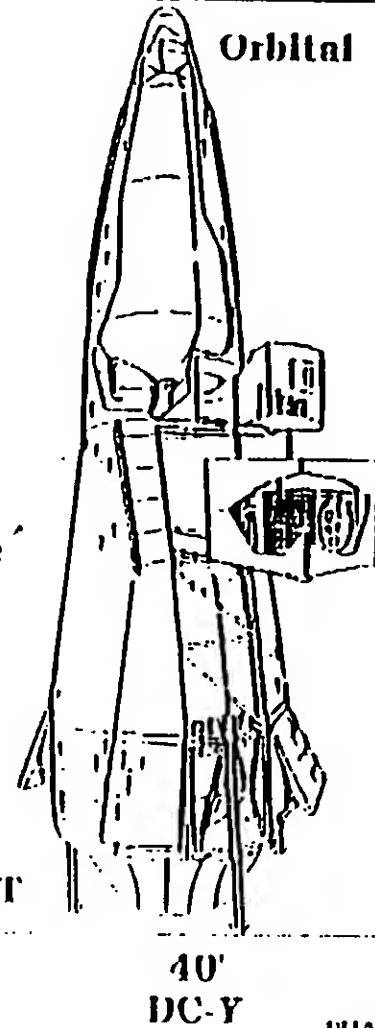
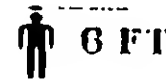
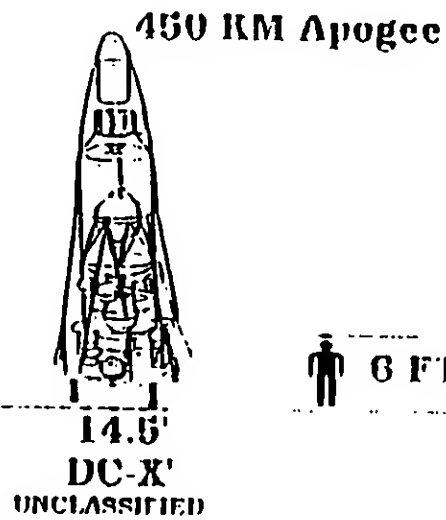
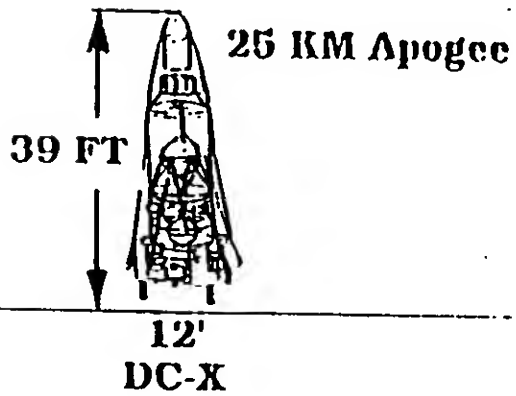


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# POTENTIAL DERIVED VEHICLES

CURRENT PROGRAM

DERIVED VEHICLES



PHASE II 2



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# SCHEDULE

## INCREMENTAL DEVELOPMENT APPROACH

FISCAL YEAR	90	91	92	93	94	95	96	97	98	99	00
Phase I Concept Exploration	Design Selection		Final Reviews		\$15M	4-WAY AIRFRAME COMPETITION					
Phase II Prototype Design & Flight Demonstration		AIP IDR FDR	DC-X Fabrication Flight Test					\$60M			
Phase III Experimental Prototype	NON SDIO ACTIVITIES							1st Flight Δ	\$510 Δ		
Phase IV Operational System											100 Δ

■ COMPLETED

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## CONCLUSIONS

---

- PHASE II IS A TECHNOLOGY DEMONSTRATION PROGRAM TO:
  - DETERMINE IF CURRENT CONCEPTS AND TECHNOLOGIES WILL SUPPORT THE DEVELOPMENT OF A SUBORBITAL RECOVERABLE ROCKET DEVELOPMENT FOR USE IN SDIO SYSTEM TESTING
- SDIO HAS NO PLAN NOR BUDGET FOR FULL SCALE ORBITAL VEHICLE DEVELOPMENT
- PHASE II EFFORTS WILL MAXIMIZE TECHNOLOGY TRANSFER TO A FUTURE ORBITAL VEHICLE

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PHASE II 7

# **Advance Planning Briefing For Industry**

## **SDI International And External Programs Overview**



**3 MAR 92**

**Dr. J. David Martin**  
**Director**

**International And External Programs**  
**Strategic Defense Initiative Organization**



# INTERNATIONAL AND EXTERNAL PROGRAMS

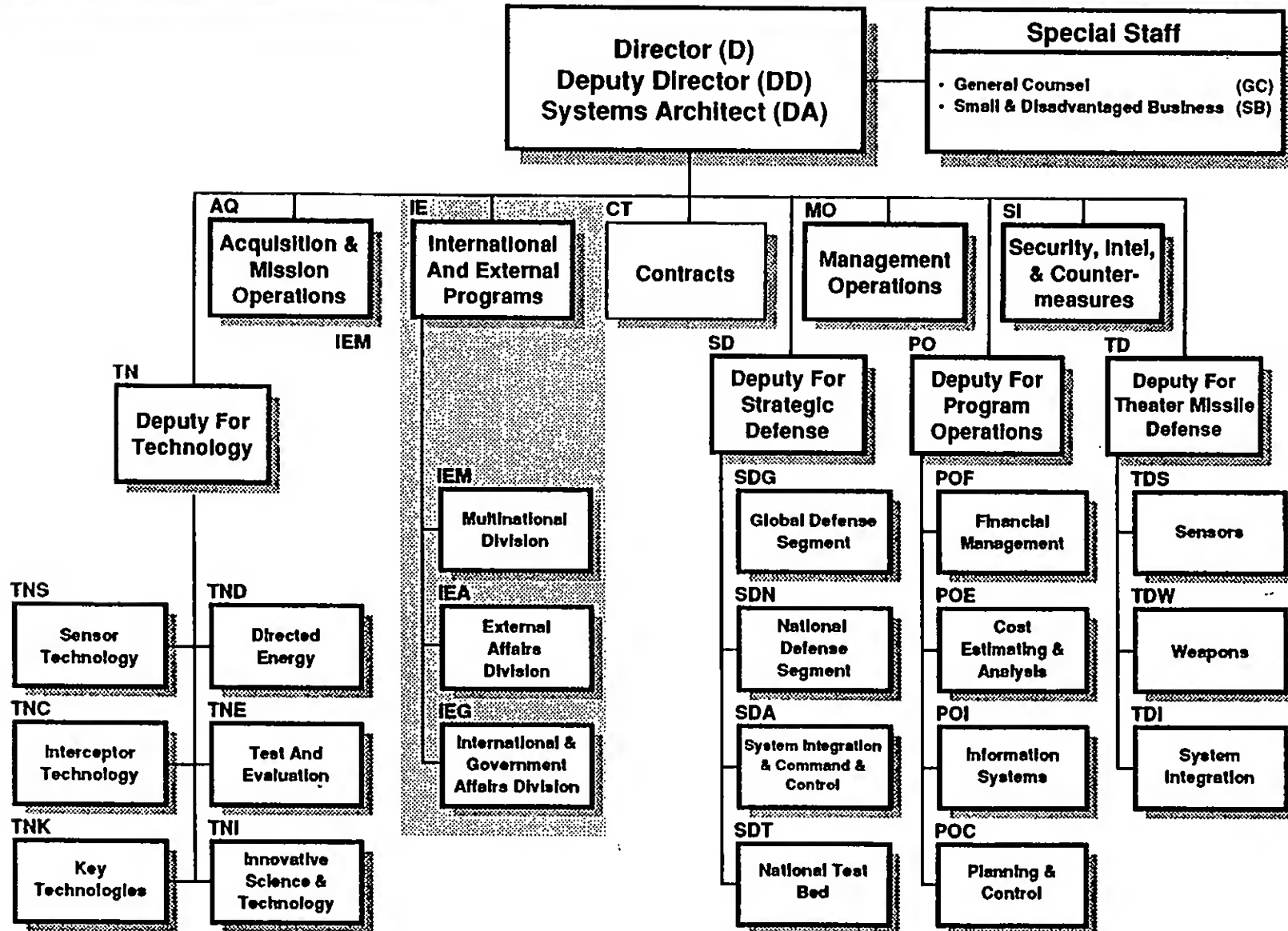
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- **Overview**
  - **Organizational Structure**
  - **Congressional Issues Impacting GPALS**
  - **Government To Government Discussions**
  - **Multinational Activities**





# STRATEGIC DEFENSE INITIATIVE ORGANIZATION





# CONGRESSIONAL ISSUES IMPACTING GPALS

---

- **Missile Defense Act Of 1991**
- **Bilateral ABM Treaty Discussions**
- **Growth Of Theater Missile Defense**



# MISSILE DEFENSE ACT OF 1991

---

## *Missile Defense Goal Of The United States*

- **It Is The Goal Of The United States To**
  - **Deploy An Antiballistic Missile System, Including One Or An Adequate Additional Number Of Antiballistic Missile Sites And Space Based Sensors, That Is Capable Of Providing A Highly Effective Defense Of The United States Against Limited Attacks Of Ballistic Missiles**
  - **Maintain Strategic Stability**
  - **Provide Highly Effective Theater Missile Defenses (TMDs) To Forward Deployed And Expeditionary Elements Of The Armed Forces Of The United States And To Friends And Allies Of The United States**



## **MISSILE DEFENSE ACT OF 1991 (Cont'd)**

---

- **ABM Treaty**
  - **Congress Urges The President To Pursue Immediate Discussions With The Soviet Union On The Feasibility And Mutual Interests Of Amendments To The ABM Treaty To Permit**
    - **Additional Ground Based Sites**
    - **Increased Use Of Spaced Based Sensors For Direct Battle Management**
    - **Clarification About Permitted Development And Testing Of Space Based Defenses**
    - **Clarification Of Distinctions Between Theater And Strategic ABM Defenses**



# THEATER MISSILE DEFENSE

---

- **Growth Industry**
  - FY 91 / \$396 M - -FY 92 / \$857 M - - -FY 96 / \$1,899 M
  
- **Several Active Defense Procurement Opportunities**
  - PATRIOT Upgrades
  - ERINT
  - CORPS SAM
  - THAAD
  - TMD-GBR
  
- **Other TMD Procurement Opportunities**
  - Architecture Studies
  - TMD Targets
  - Attack Ops / Counter Force
  - Test Beds
  - BM / C<sup>3</sup>
  - Passive Defense
  - Advanced Technology Demonstrations
    - Lethality
    - Sensors
    - Discrimination



# GOVERNMENT TO GOVERNMENT DISCUSSIONS

---

- **Five Nations Have Signed Memoranda Of Understanding To Participate In SDI**
- **Other Nations Are Also Actively Involved In SDI Research**
- **Recent NATO Strategy Recognizes Problem Arising From Missile Technology Proliferation**
- **Many Allies Are Thinking About The Need For Missile Defenses**



# **PARTICIPATION OF ALLIES / FRIENDS**

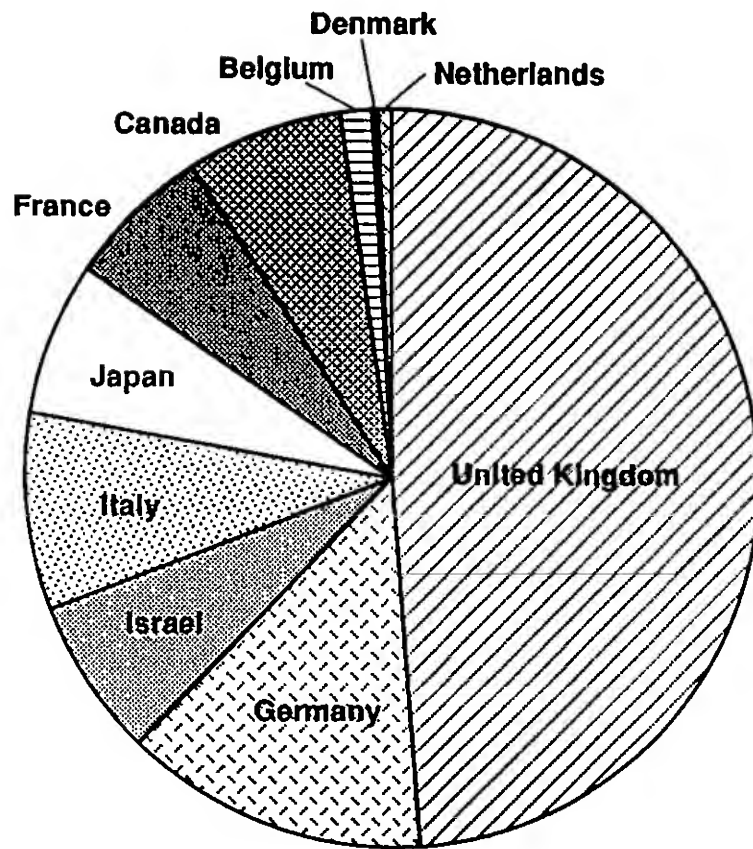
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- **Allied Participation In SDI Predates Refocus Toward GPALS**
- **U.S. Open To Many Avenues Of Participation And Cooperation**
  - **Wants To Discuss With Allies / Friends Their Interests / Ideas**
- **General Areas For Participation In GPALS**
  - **Participation In SDIO's Basic Research And Development Programs For GPALS**
  - **Government To Government Cooperation, Specifically In TMD Aspects Of GPALS**
  - **Independent Acquisition Of TMD Systems Which Would Be Interoperable With U.S. GPALS Elements**
    - **Indigenously Developed**
    - **Purchased From Another Country Such As U.S.**

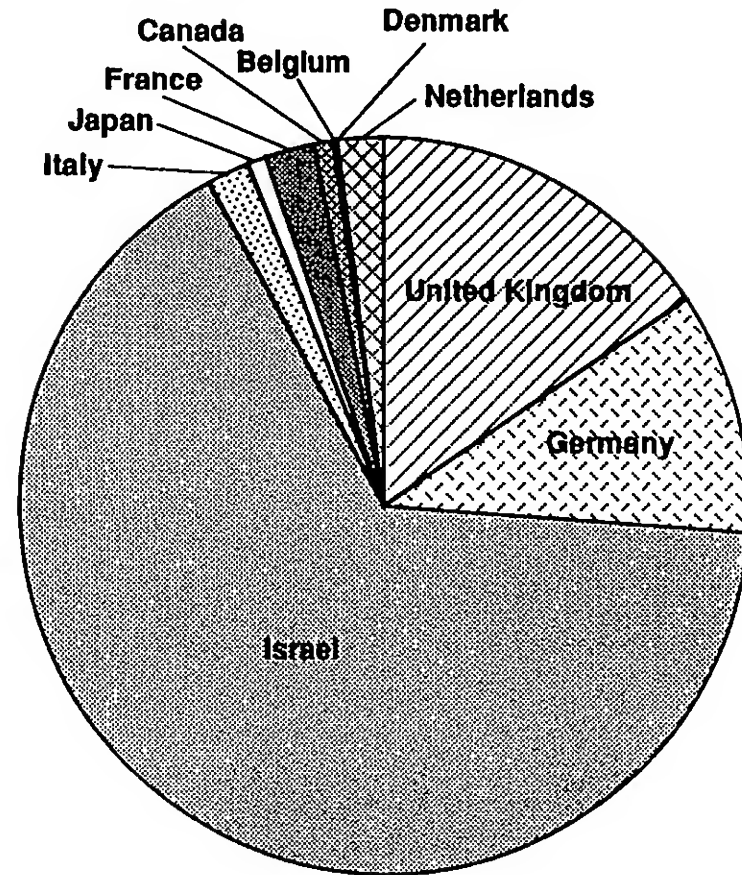


# ALLIED PARTICIPATION

## 303 Contracts



## \$833.33 Million







## STATUS OF ALLIED CONTRACTS

Country	Number Of Contracts	\$ Values (M)
United Kingdom	148	129.10
Germany	40	88.55
Israel	22	549.24 *
Italy	25	15.11
Japan	20	6.00
France	19	17.37
Canada	21	8.00
Belgium	4	0.52
Denmark	1	0.03
The Netherlands	3	19.41 **
<b>Total</b>	<b>303</b>	<b>\$833.33</b>

\* Includes \$137.160 Million Contribution By Israel

\*\* Includes \$7 Million Contribution By The Netherlands



## SDIO COOPERATIVE ARRANGEMENTS WITH ALLIES

<i>Country</i>	<i>Program</i>	<i>\$ In Millions Value</i>	<i>US / Ally Funding (Approximate)</i>
UK	Data Fusion	26.000	40% / 60%
UK	Flight Test	20.000	50% / 50%
UK	Extended Air Defense Test Bed	19.300	60% / 40%
UK	Artificial Intelligence	0.685	80% / 20%
Israel	Arrow Experiment	158.000	80% / 20%
Israel	Arrow Continuation Experiments	322.00	72% / 28%
Israel	Theater Missile Defense Test Bed	33.100	72% / 28%
Israel	Hybrid Electromagnetic Gun	3.088	80% / 20%
Japan	Western Pacific Architecture Study	6.500	90% / 10%
France	Free Electron Laser (FEL) MOA	—	—
Netherlands	Hypervelocity Gun Test	12.000	40% / 60%

# **STRATEGIC DEFENSE INITIATIVE**

## **Program Budget Considerations**



**3 MAR 92**

**Lt Col Steve Mullen, USAF  
Assistant Director, Financial Management Directorate  
Program Operations  
Strategic Defense Initiative Organization**

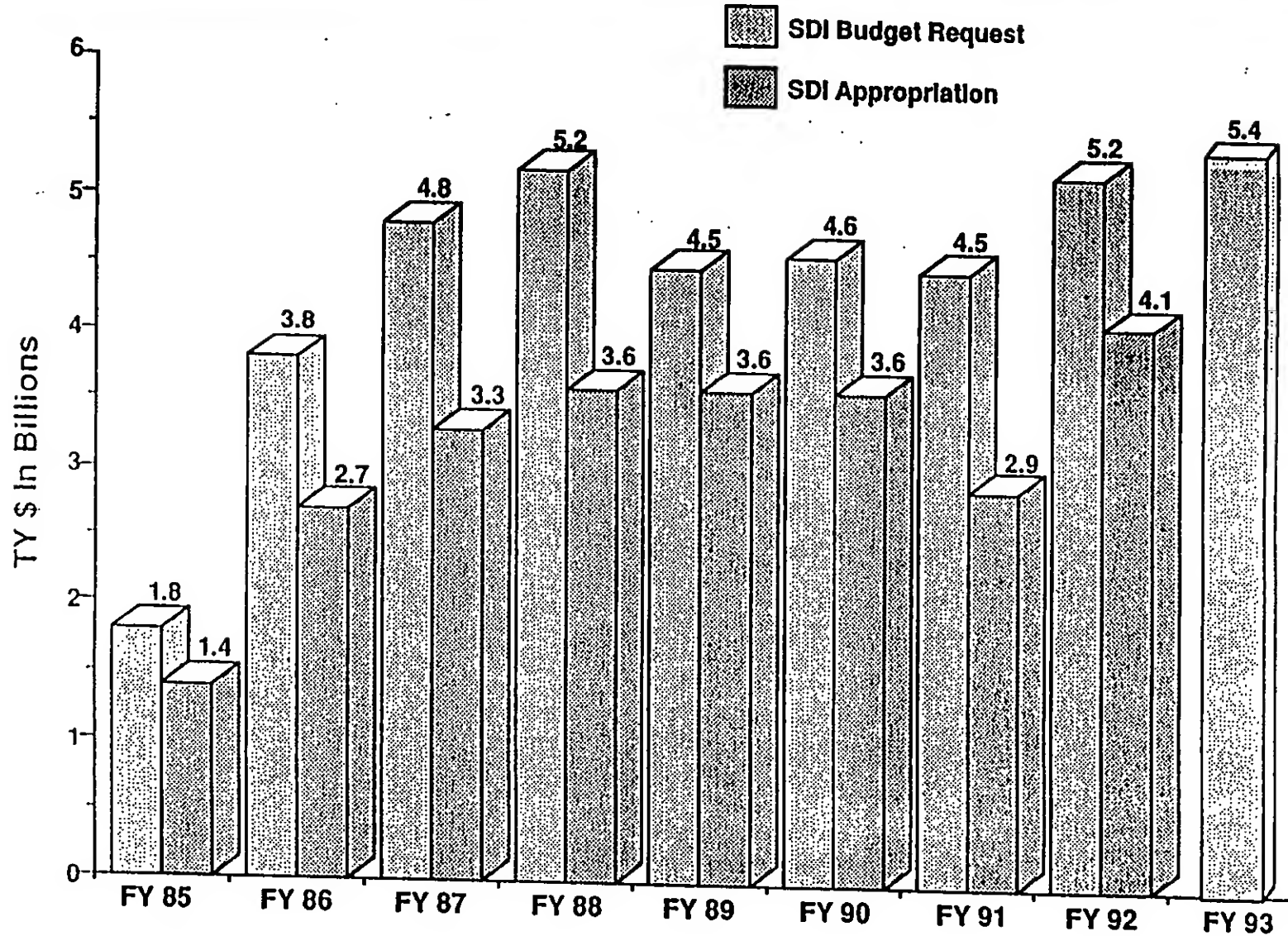


# PROGRAM ELEMENT STRUCTURE

<b>FY 85 - 89</b>	<b>FY 90</b>	<b>FY 91</b>	<b>FY 92 - 97</b>
<b>SATKA</b>	<b>SATKA</b>	<b>Phase I</b>	<b>Space Based Interceptor</b>
<b>KEW</b>	<b>KEW</b>	<b>LPS</b>	<b>Limited Defensive Sys</b>
<b>DEW</b>	<b>DEW</b>	<b>TMD</b>	<b>Theater Missile Defense</b>
<b>SA / BM</b>	<b>SA / BM</b>	<b>TMDI</b>	
<b>SLKT</b>	<b>SLKT</b>	<b>Follow-on</b>	<b>Other Follow-on</b>
<b>Hq Mgt</b>		<b>Res &amp; Support</b>	<b>Res &amp; Support</b>

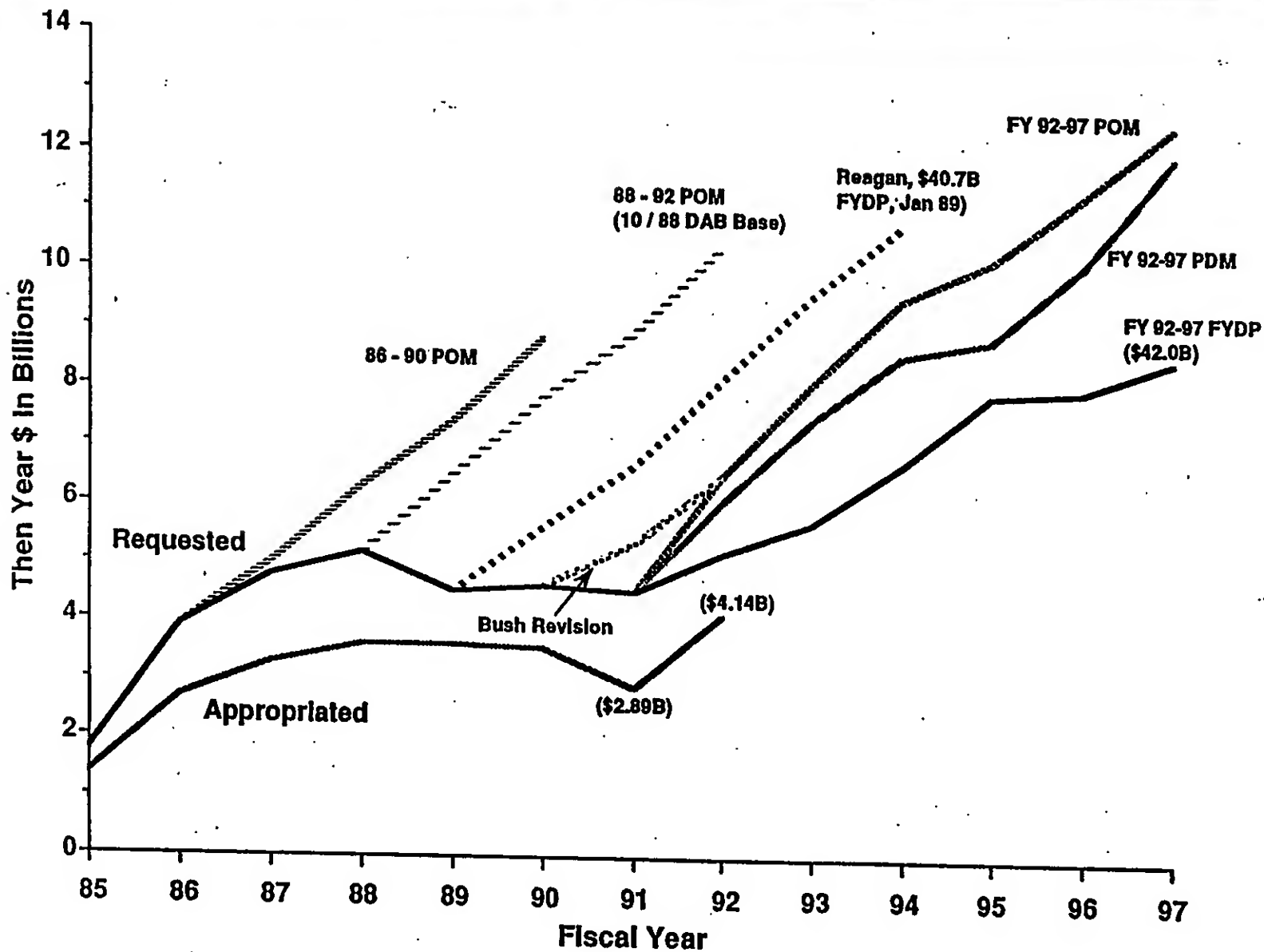


# STRATEGIC DEFENSE INITIATIVE



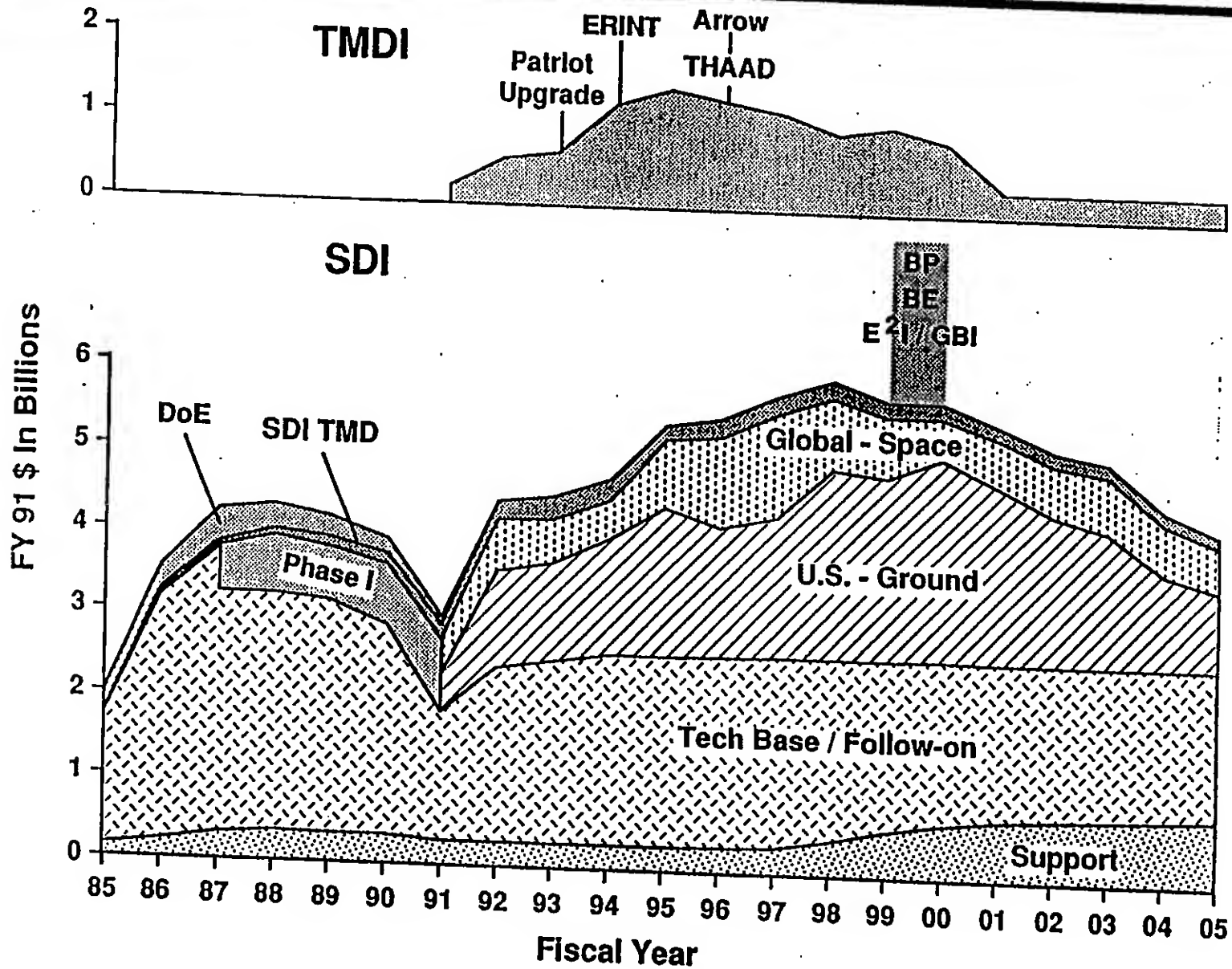


# PROGRAM BUDGET HISTORY



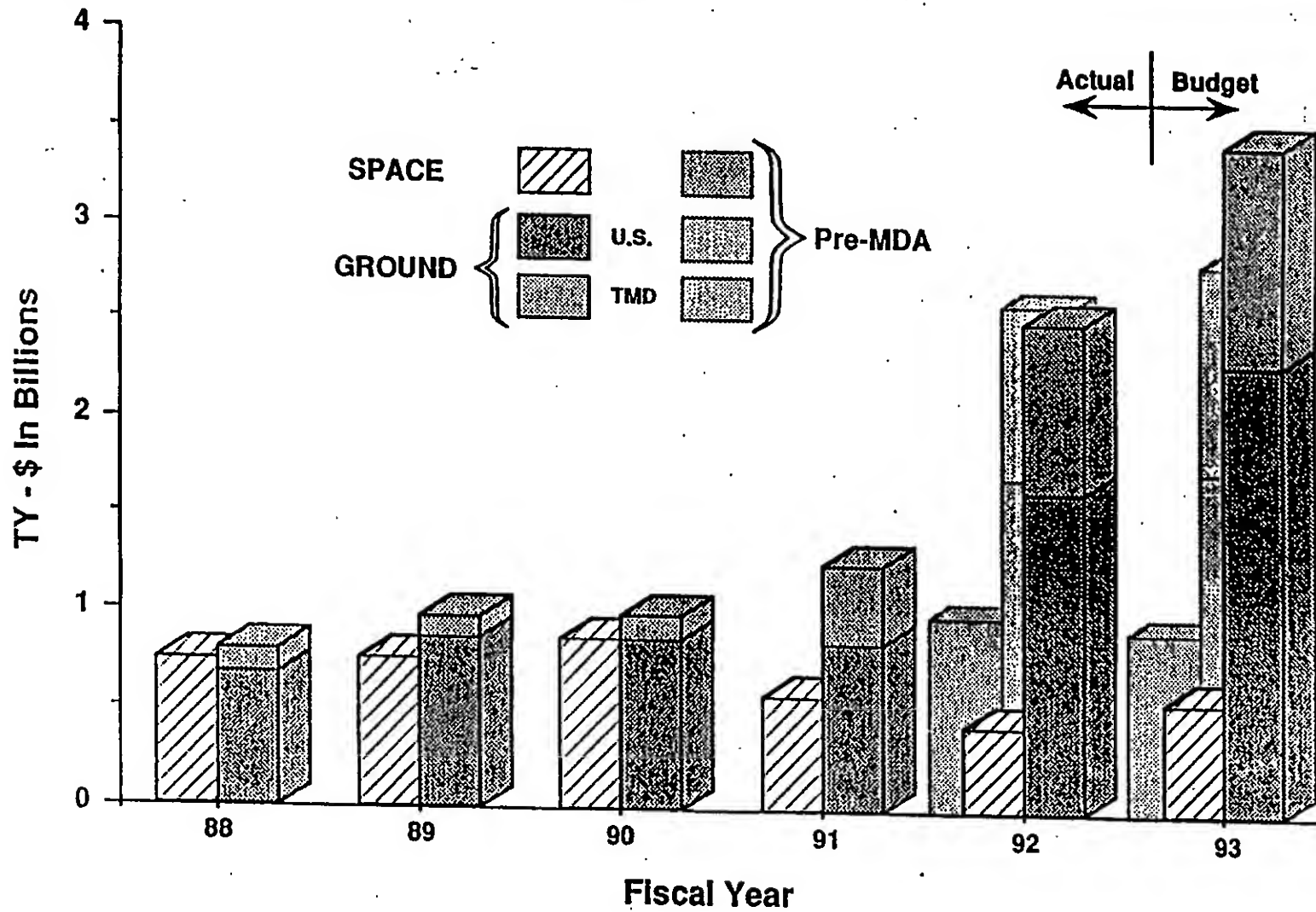


# BMD BUDGET EVOLUTION





# SPACE - GROUND R&D INVESTMENTS







# STRATEGIC DEFENSE INITIATIVE FY 93 AMENDED BUDGET FYDP PROGRAM

*TY \$ In Thousands*

RDTE	FY 91	FY 92	FY 93
<b>Dem / Val 6.3</b>			
Theater Missile Defense	178,452	802,710	857,725
Limited Defense System	394,148	1,434,343	2,134,755
Space Based Interceptor	867,583	466,069	575,558
Follow-on	697,479	666,352	849,596
Research And Support	731,150	715,027	754,740
<b>Total Dem / Val</b>	<b>2,868,812</b>	<b>4,084,501</b>	<b>5,172,374</b>
<b>EMD 6.4</b>			
Theater Missile Defense		31,000	140,000
Limited Defense System			
Space Based Interceptor			
<b>Total EMD</b>		<b>31,000</b>	<b>140,000</b>
<b>Total RDTE</b>	<b>2,868,812</b>	<b>4,115,501</b>	<b>5,312,374</b>
<b>Procurement</b>			
Theater Missile Defense		25,000	62,500
Limited Defense System			
<b>Total Procurement</b>		<b>25,000</b>	<b>62,500</b>
<b>MILCON</b>			
Limited Defense System			40,200
Space Based Interceptor	3,870		
Research And Support	6,000	5,100	10,000
<b>Total MILCON</b>	<b>9,870</b>	<b>5,100</b>	<b>50,200</b>
<b>Total SDIO</b>	<b>2,878,682</b>	<b>4,145,601</b>	<b>5,425,074</b>



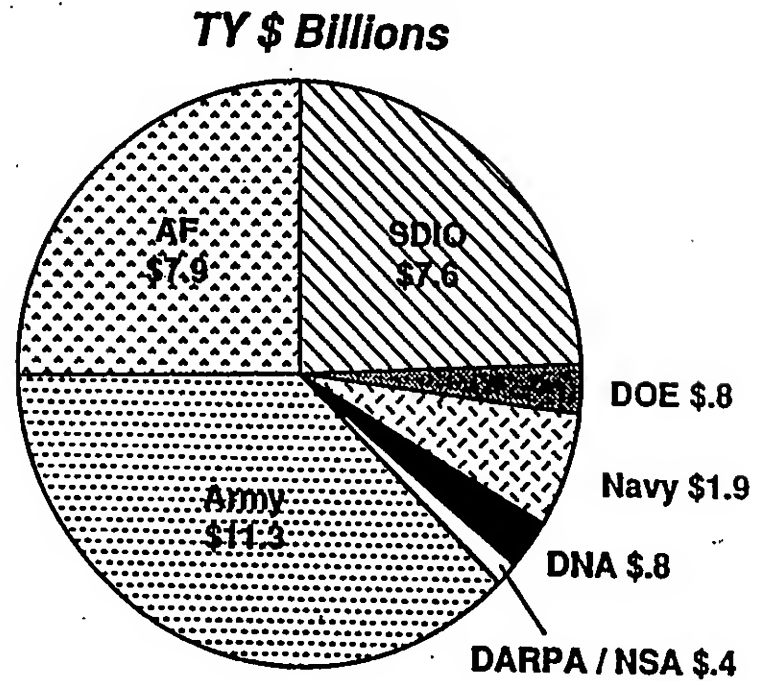
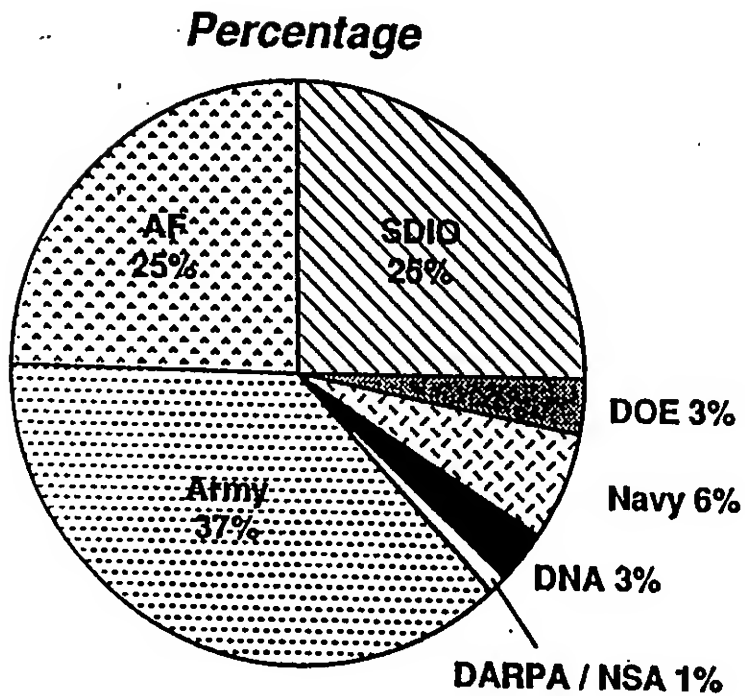
# STRATEGIC DEFENSE INITIATIVE ORGANIZATION EXECUTING AGENT DISTRIBUTION

*(\$ In Millions)*

<u>Executing Agent</u>	<u>FY 90</u>	<u>FY 91</u>	<u>FY 92</u>	<u>FY 93</u>	<u>%</u>
DARPA	1.000	0.000	.000	.000	>1
DNA	67.517	42.955	55.029	52.405	1
DOE	161.036	222.647	141.125	116.240	2
NSA	.000	.000	10.284	10.803	>1
SDIO	737.973	854.975	1376.397	2079.733	39
U.S. Air Force	1151.339	563.830	502.308	777.123	14
U.S. Army	1297.799	1060.814	1828.090	2166.398	40
U.S. Navy	182.563	132.611	231.608	221.727	4
USSPACECOM	<u>1.001</u>	<u>.850</u>	<u>.760</u>	<u>.645</u>	>1
SDI Total	3600.228	2878.682	4145.601	5425.074	



# STRATEGIC DEFENSE INITIATIVE BY EXECUTING AGENT FY 85 - 93





# FY 93 AMENDED PRESIDENT'S BUDGET

*TY \$ In Millions*

RDT&E	FY 92			FY 93		
	FY 92 / 93 Budget	Delta	FY 93 Amended Budget	FY 92 / 93 Budget	Delta	FY 93 Amended Budget
Theater Missile Defense	857.5	-23.8	833.7	890.7	+107.0	997.7
Limited Defensive Sys	1,600.4	-166.1	1,434.3	1,736.8	+398.0	2,134.8
Space Based Interceptor	829.9	-363.8	466.1	768.4	-192.8	575.6
Follow-on	1,168.2	-501.8	666.4	1,255.9	-406.3	849.6
Research And Support	694.6	+20.4	715.0	831.4	-76.7	754.7
<b>Total</b>	<b>5,150.6</b>	<b>-1,035.1</b>	<b>4,115.5</b>	<b>5,483.2</b>	<b>-170.8</b>	<b>5,312.4</b>



# CONTRACT TERMINATIONS FY 92 APPROPRIATION

Program	Title	(\$000)	# Of People	Contractors / Subcontractors	City / State
1101	Passive Sensors	1,975	104	Rockwell Hughes Aerojet NRC TRW Spire Corp Harris	Anahelm, CA El Segundo, CA Sacramento, CA Colorado Springs, CO Redondo Beach, CA Boston, MA Melbourne, FL
1103	Laser Radar	178	4	Laser Science	Cambridge, MA
1104	Signal Processing	1,645	72	Honeywell Raytheon Phillips Lab David Sarnoff Spire Corp Allied Signal IBIS N.C. State Univ Of FL Texas Instruments	Plymouth, MN Sudbury, MA Hanscom AFB, MA Princeton, NJ Bedford, MA Columbia, MD Danvers, MA Raleigh, NC Gainesville, FL Dallas, TX
1201	Interceptor Component Technology	2,212	13	Thlokai Aerojet Westinghouse	Huntsville, AL Sacramento, CA Pittsburgh, PA

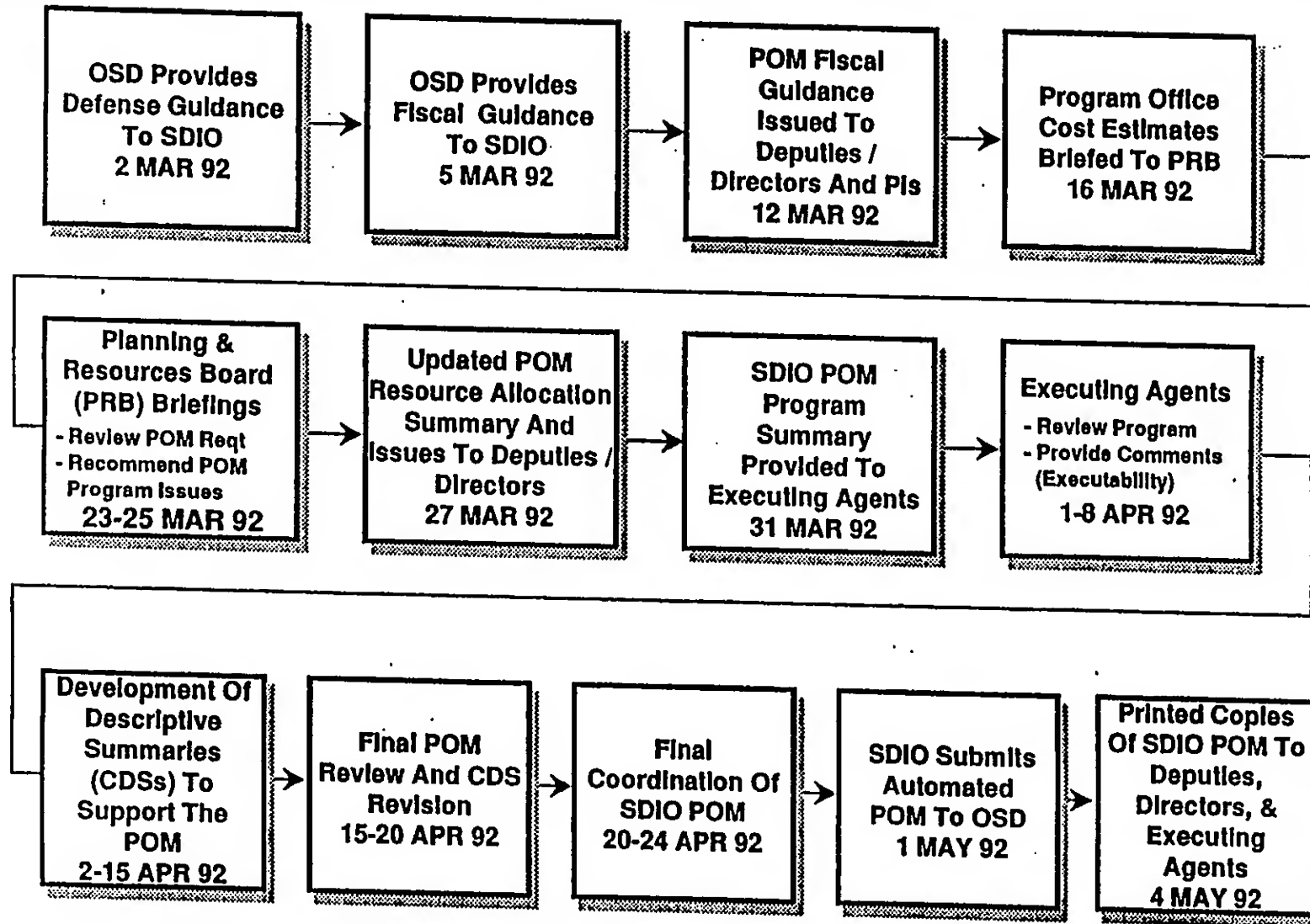


# CONTRACT TERMINATIONS FY 92 APPROPRIATION (Cont'd)

<u>Program</u>	<u>Title</u>	<u>(\$000)</u>	<u># Of People</u>	<u>Contractors / Subcontractors</u>	<u>City / State</u>
1302	Chemical Laser	14,558	10	United Tech	West Palm Beach, FL
1303	Neutral Particle Beam	3,939	73	Grumman Corp	Long Island, NY
				Kirk Meyer Co	Santa Fe, NM
				Butler Svcs	Santa Fe, NM
				Salem Technical	Santa Fe, NM
				DOE	Los Alamos, NM
				Mission Rsch	Albuquerque, NM
				Spectra Tech	Bellview, WA
				Titan Tech	Albuquerque, NM
				Univ Of NM	Albuquerque, NM
				K-Tech	Albuquerque, NM
				Sandia Lab	Sandia Base, NM
1503	Power + Power Cond	10,000	15	GE	San Jose, CA
				GE	Valley Forge, PA
				Westinghouse	Pittsburgh, PA
				TECO	Boston, MA
1105	Discrimination	1,183	27	Hughes	El Segundo, CA
				Boeing	Seattle, WA
				Nichols	Huntsville, AL



# SDIO FY 94 - 99 POM PROCESS



# STRATEGIC DEFENSE INITIATIVE

## Technical Information Center

### Information Briefing



3 MAR 92

Mrs. Jeanette Clay  
Information Systems Directorate  
Strategic Defense Initiative Organization





## PURPOSE OF BRIEFING

---

- **Provide Awareness Of The Existence Of The Strategic Defense Initiative (SDI) Technical Information Center (TIC) And The Functions Available To SDIO Contractors And Government Personnel**



# TIC MISSION

---

- **Serve As The SDI Library**
- **Conduct Current Awareness Activities**
- **Operate A Bidders Library**
- **Operate A Data Management Library**



# SDI LIBRARY FUNCTIONS

---

- **Collect And Provide Access To Basic Scientific, Technical, And Programmatic Documentation Needed By The Entire SDI Community And Its Contractors**
  - **Collect Current And Historical Data**
  - **Provide Unclassified And Classified Reading Rooms**
  - **Perform Keyword Searches Of Databases For Required Material**
- **Respond To Bibliographic And Technical Inquiries**
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- **Provide Access To A Microfilm Library Of DoD Directives, MIL-STDs, FIPs, MIL-SPECS, And MIL-HBKs**



## RESOURCES AVAILABLE

---

- **Over 35,000 Documents Related To SDI Program**
- **Documents Include Books, Audio And Videotapes, Maps, And Engineering Drawings**
- **More Than 40 Specialized Journals, Newsletters, Other Material Focusing On SDI Related Science, Technology, And Policy Issues**
- **Collections Include / Will Include: DART / DAB, Theater Missile, Projected Defender, Environmental, BP, Directed Energy, And References To Other Appropriate Collections Such As Threat And Survivability**



# INFORMATION SOURCES

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- **Documents Acquired From**
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  - **SDI Contractors**
  - **Government Agencies And Departments**
  
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- **Online Access To External Database Services Such As**
  - **Dialog**
  - **DROLS (DTIC)**
  - **Newsnet**
  - **Lexis / Nexis**



# DIALOG

---

- **Over 350 Databases In Excess Of 200 Million Records**
- **Books And Monographs - Library Of Congress**
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## **DROLS (DTIC)**

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- **Work Unit Information System Database - Research Being Performed, By Whom, Effort, Dollars, etc.**
- **IR&D Database - Descriptions Of Technical Programs Not Wholly Funded By DoD. Used To Avoid Duplicating Ongoing Efforts And Identify Contractors With Expertise Of Interest To DoD**



# NEWSNET

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- **A Database Of Newsletters Covering Worldwide Events And Business News**
- **Over 380 Business Newsletters (Space Daily, Space Business News, Defense Daily, Defense R&D Update, C31 Report, Advances Military Computing, Military Space, SDI Monitor, NASA SW Directory)**
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## LEXIS / NEXIS

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- **World's Largest Full Text On-line Database. Covers Law, Regulation, Legislation, People In Government International Information, Global News**
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## **CURRENT AWARENESS ACTIVITIES**

---

- **Publish The Weekly "Tech Center Update" Containing Summaries Of News Publications And Journals**
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\* **Avallability Of GFI Subject To Terms And Condlions Mutually Agreed Upon Between SDIO And Executng Agents**



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  - **Weekly Tech Center Updates**
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  - **Documents Of Interest To SDI**



## SDI TIC SITE INFORMATION

---

**Address:** SDI TIC  
1755 Jefferson Davis Highway  
Suite 708  
Arlington, Virginia 22202

**Telephone:** (703) 521-7703

**Fax:** (703) 521-4123  
(703) 521-9737 (Security)

**Hours Of Operation:** Unclassified 8:00 am To 5:00 pm  
Classified 8:00 am To 4:30 pm

**STRATEGIC DEFENSE INITIATIVE**  
**Technical Information Center**  
**Information Briefing**



**3 MAR 92**

**Mrs. Jeanette Clay**  
**Information Systems Directorate**  
**Strategic Defense Initiative Organization**



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# **STRATEGIC DEFENSE INITIATIVE**

## **Program Budget Considerations**



**3 MAR 92**

**Lt Col Steve Mullen, USAF  
Assistant Director, Financial Management Directorate  
Program Operations  
Strategic Defense Initiative Organization**

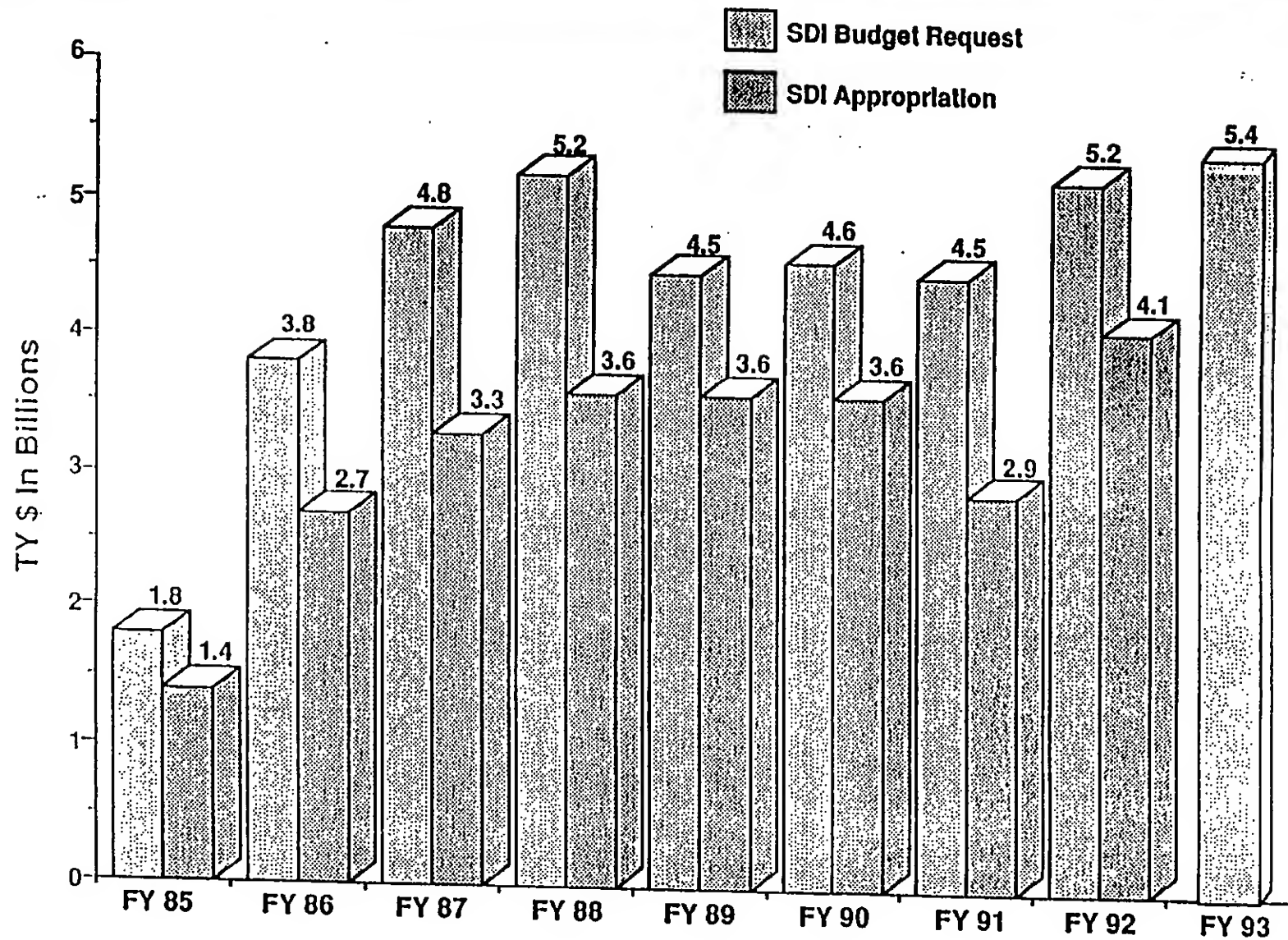


# PROGRAM ELEMENT STRUCTURE

FY 85 - 89	FY 90	FY 91	FY 92 - 97
SATKA	SATKA	Phase I	Space Based Interceptor
KEW	KEW	LPS	Limited Defensive Sys
DEW	DEW	TMD	Theater Missile Defense
SA / BM	SA / BM	TMDI	
SLKT	SLKT	Follow-on	Other Follow-on
Hq Mgt		Res & Support	Res & Support



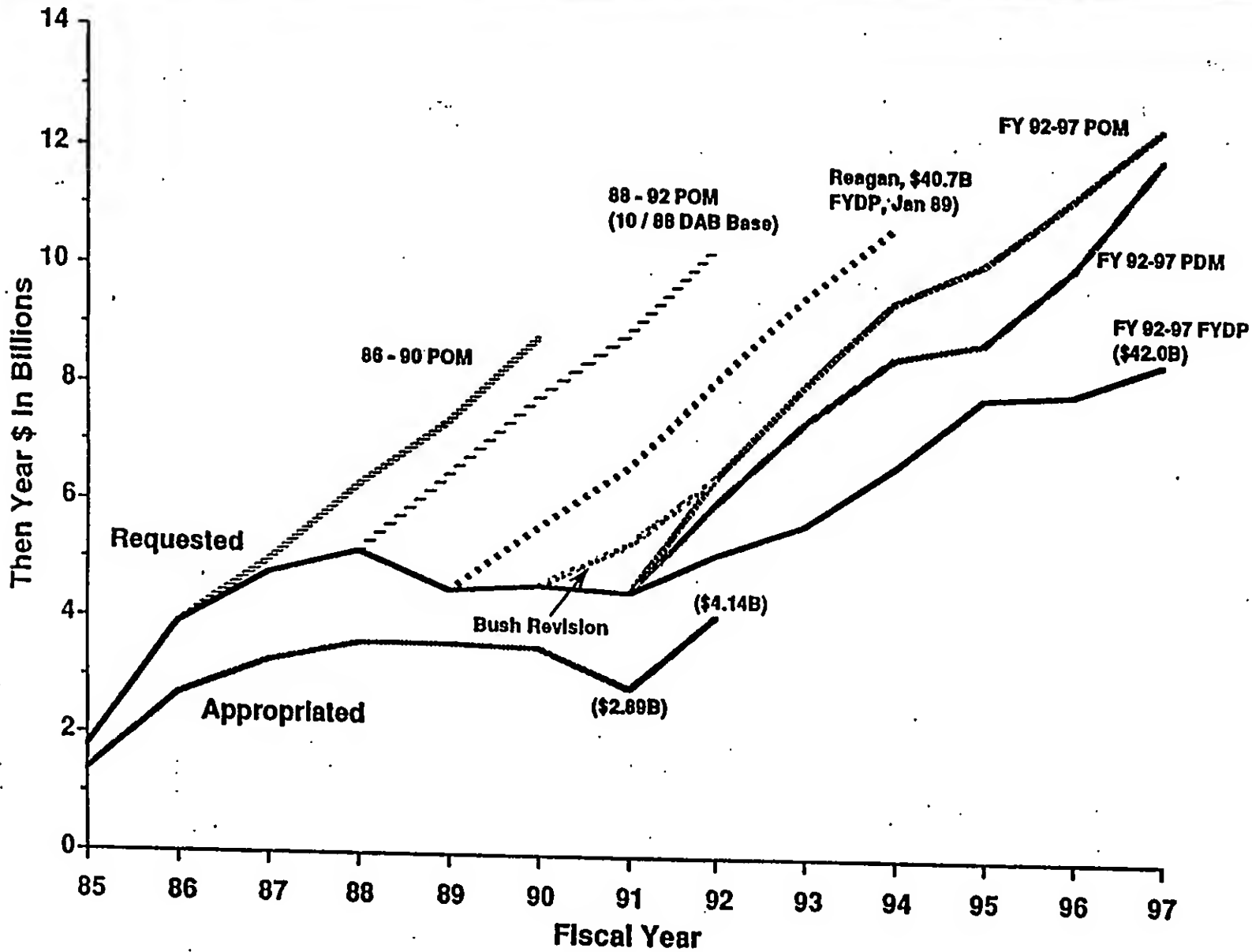
# STRATEGIC DEFENSE INITIATIVE





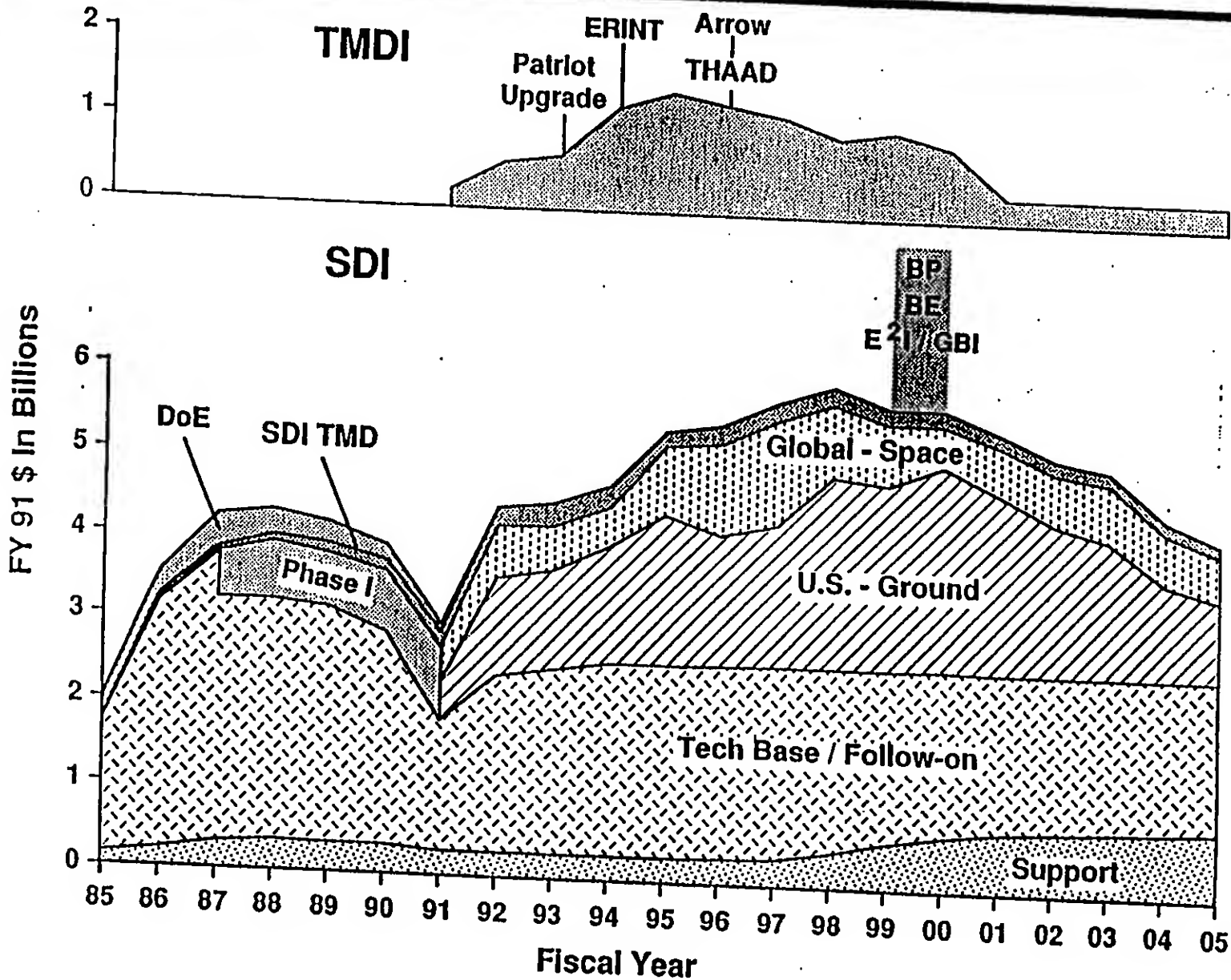


# PROGRAM BUDGET HISTORY



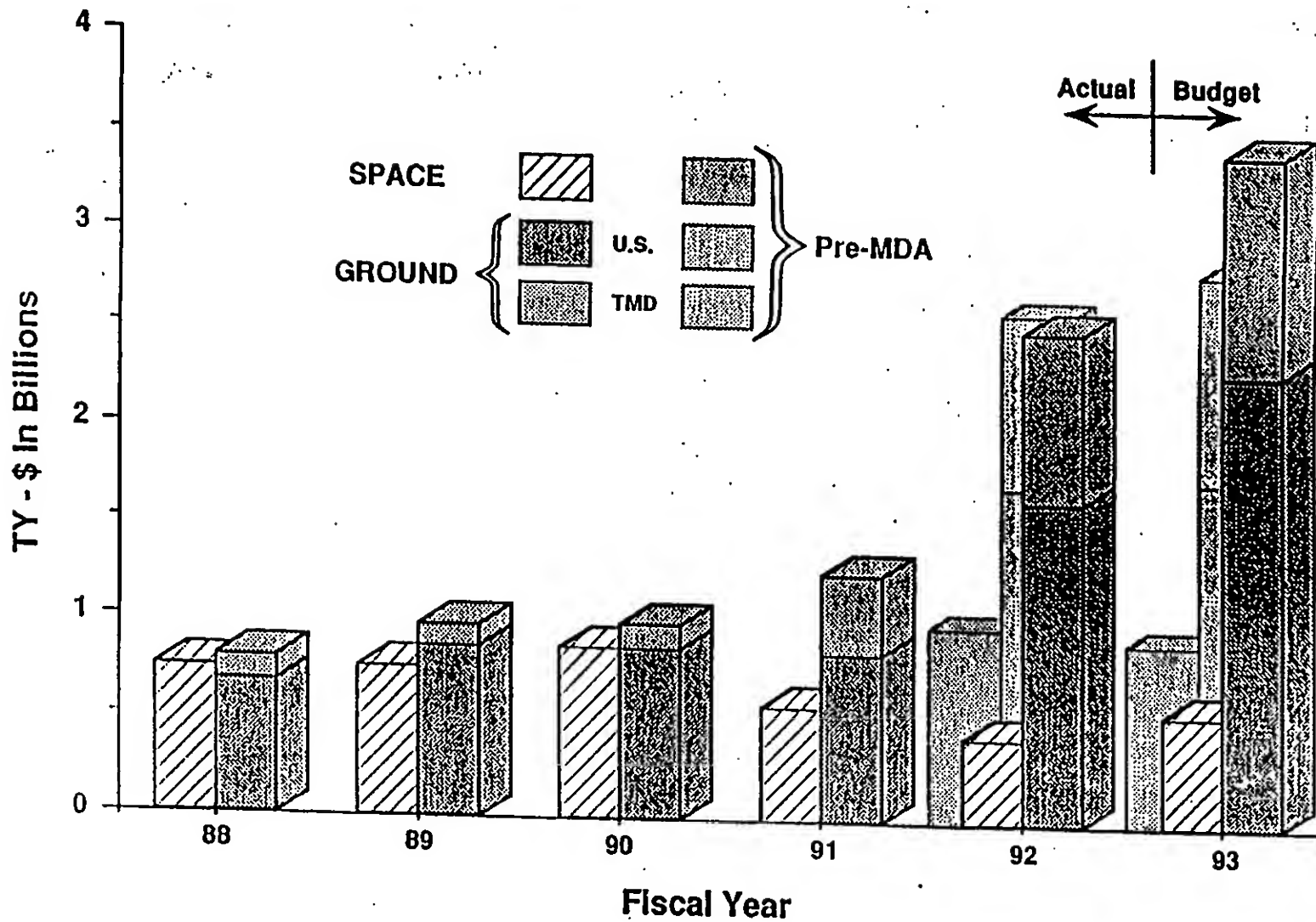


# BMD BUDGET EVOLUTION





# SPACE - GROUND R&D INVESTMENTS





# STRATEGIC DEFENSE INITIATIVE FY 93 AMENDED BUDGET FYDP PROGRAM

*TY \$ In Thousands*

RDTE	FY 91	FY 92	FY 93
<b>Dem / Val 6.3</b>			
Theater Missile Defense	178,452	802,710	857,725
Limited Defense System	394,148	1,434,343	2,134,755
Space Based Interceptor	867,583	466,069	575,558
Follow-on	697,479	666,352	849,596
Research And Support	731,150	715,027	754,740
<b>Total Dem / Val</b>	<b>2,868,812</b>	<b>4,084,501</b>	<b>5,172,374</b>
<b>EMD 6.4</b>			
Theater Missile Defense		31,000	140,000
Limited Defense System			
Space Based Interceptor			
<b>Total EMD</b>		<b>31,000</b>	<b>140,000</b>
<b>Total RDTE</b>	<b>2,868,812</b>	<b>4,115,501</b>	<b>5,312,374</b>
<b>Procurement</b>			
Theater Missile Defense		25,000	62,500
Limited Defense System			
<b>Total Procurement</b>		<b>25,000</b>	<b>62,500</b>
<b>MILCON</b>			
Limited Defense System			40,200
Space Based Interceptor	3,870		
Research And Support	6,000	5,100	10,000
<b>Total MILCON</b>	<b>9,870</b>	<b>5,100</b>	<b>50,200</b>
<b>Total SDIO</b>	<b>2,878,682</b>	<b>4,145,601</b>	<b>5,425,074</b>



# STRATEGIC DEFENSE INITIATIVE ORGANIZATION EXECUTING AGENT DISTRIBUTION

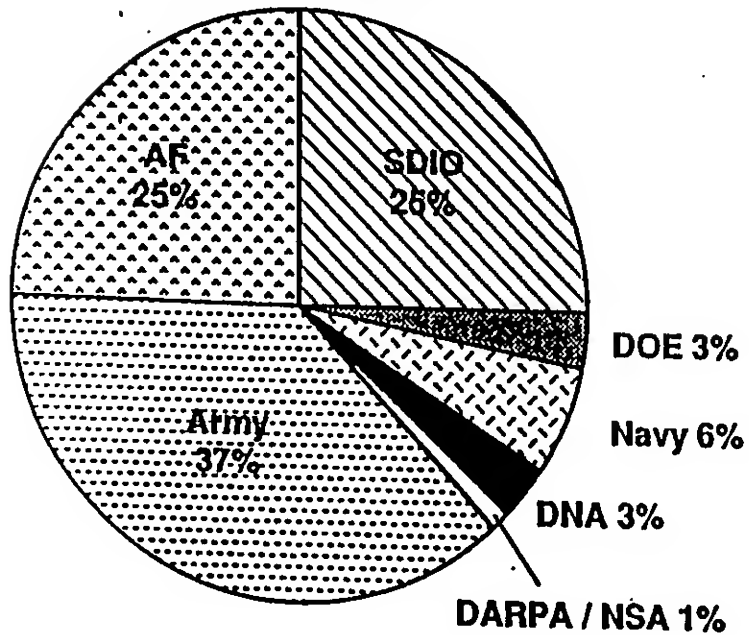
*(\$ In Millions)*

<u>Executing Agent</u>	<u>FY 90</u>	<u>FY 91</u>	<u>FY 92</u>	<u>FY 93</u>	<u>%</u>
DARPA	1.000	0.000	.000	.000	>1
DNA	67.517	42.955	55.029	52.405	1
DOE	161.036	222.647	141.125	116.240	2
NSA	.000	.000	10.284	10.803	>1
SDIO	737.973	854.975	1376.397	2079.733	39
U.S. Air Force	1151.339	563.830	502.308	777.123	14
U.S. Army	1297.799	1060.814	1828.090	2166.398	40
U.S. Navy	182.563	132.611	231.608	221.727	4
USSPACECOM	<u>1.001</u>	<u>.850</u>	<u>.760</u>	<u>.645</u>	>1
SDI Total	3600.228	2878.682	4145.601	5425.074	

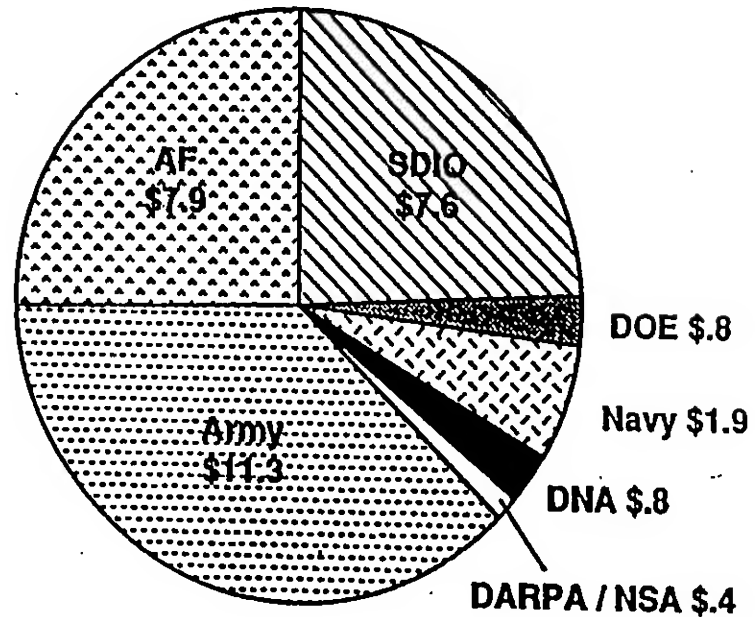


# STRATEGIC DEFENSE INITIATIVE BY EXECUTING AGENT FY 85 - 93

**Percentage**



**TY \$ Billions**





# FY 93 AMENDED PRESIDENT'S BUDGET

*TY \$ In Millions*

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	FY 92 / 93 Budget	Delta	FY 93 Amended Budget	FY 92 / 93 Budget	Delta	FY 93 Amended Budget
Theater Missile Defense	857.5	-23.8	833.7	890.7	+107.0	997.7
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# CONTRACT TERMINATIONS FY 92 APPROPRIATION

<u>Program</u>	<u>Title</u>	<u>(\$000)</u>	<u># Of People</u>	<u>Contractors / Subcontractors</u>	<u>City / State</u>
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1103	Laser Radar	178	4	Laser Science	Cambridge, MA
1104	Signal Processing	1,645	72	Honeywell Raytheon Phillips Lab David Sarnoff Spire Corp Allied Signal IBIS N.C. State Univ Of FL Texas Instruments	Plymouth, MN Sudbury, MA Hanscom AFB, MA Princeton, NJ Bedford, MA Columbia, MD Danvers, MA Raleigh, NC Gainesville, FL Dallas, TX
1201	Interceptor Component Technology	2,212	13	Thlokai Aerojet Westinghouse	Huntsville, AL Sacramento, CA Pittsburgh, PA



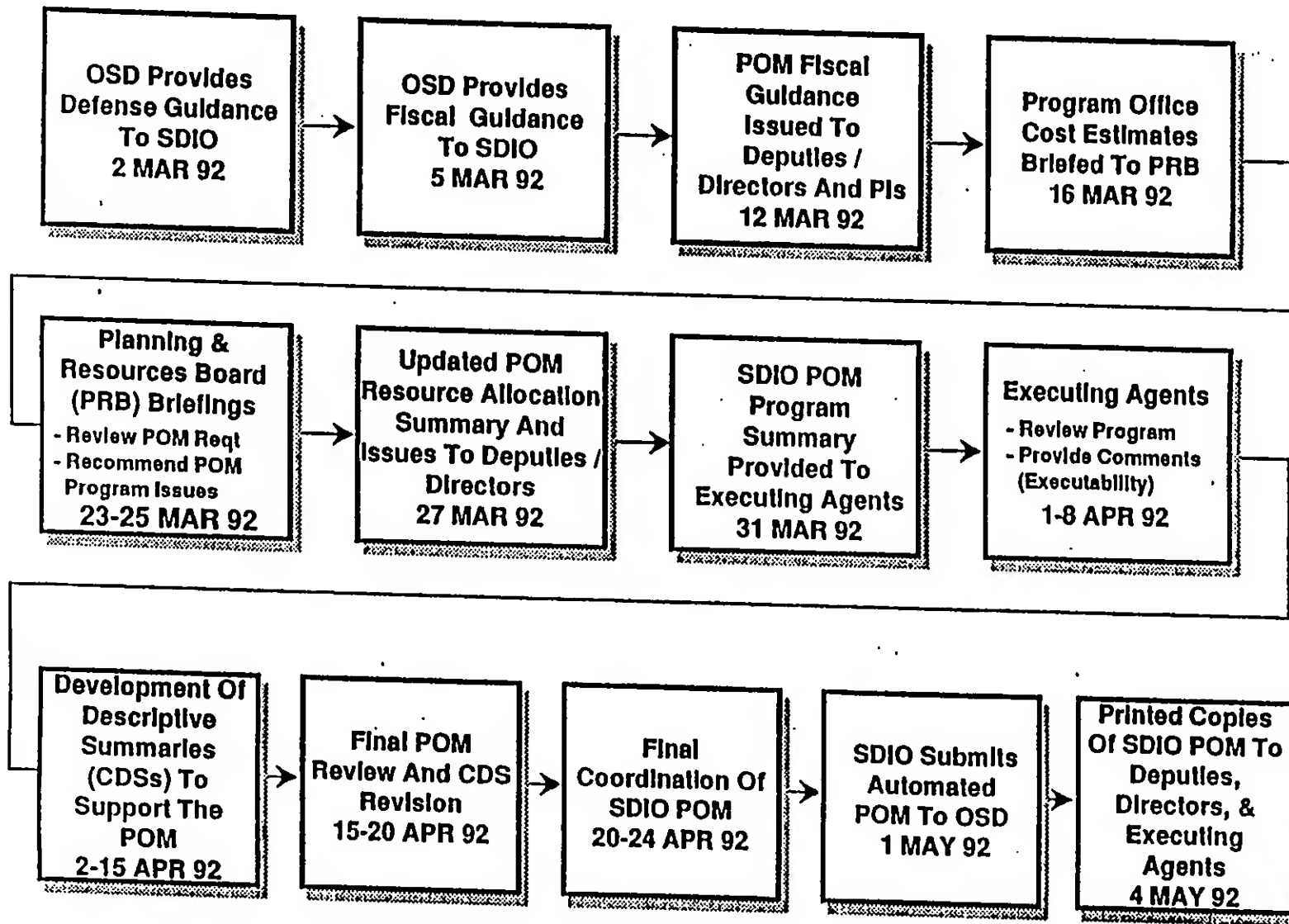


# CONTRACT TERMINATIONS FY 92 APPROPRIATION (Cont'd)

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				Salem Technical	Santa Fe, NM
				DOE	Los Alamos, NM
				Mission Rsch	Albuquerque, NM
				Spectra Tech	Bellview, WA
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				Univ Of NM	Albuquerque, NM
				K-Tech	Albuquerque, NM
				Sandia Lab	Sandia Base, NM
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# SDIO FY 94 - 99 POM PROCESS



# STRATEGIC DEFENSE INITIATIVE

## Strategic Defense In The 1990's

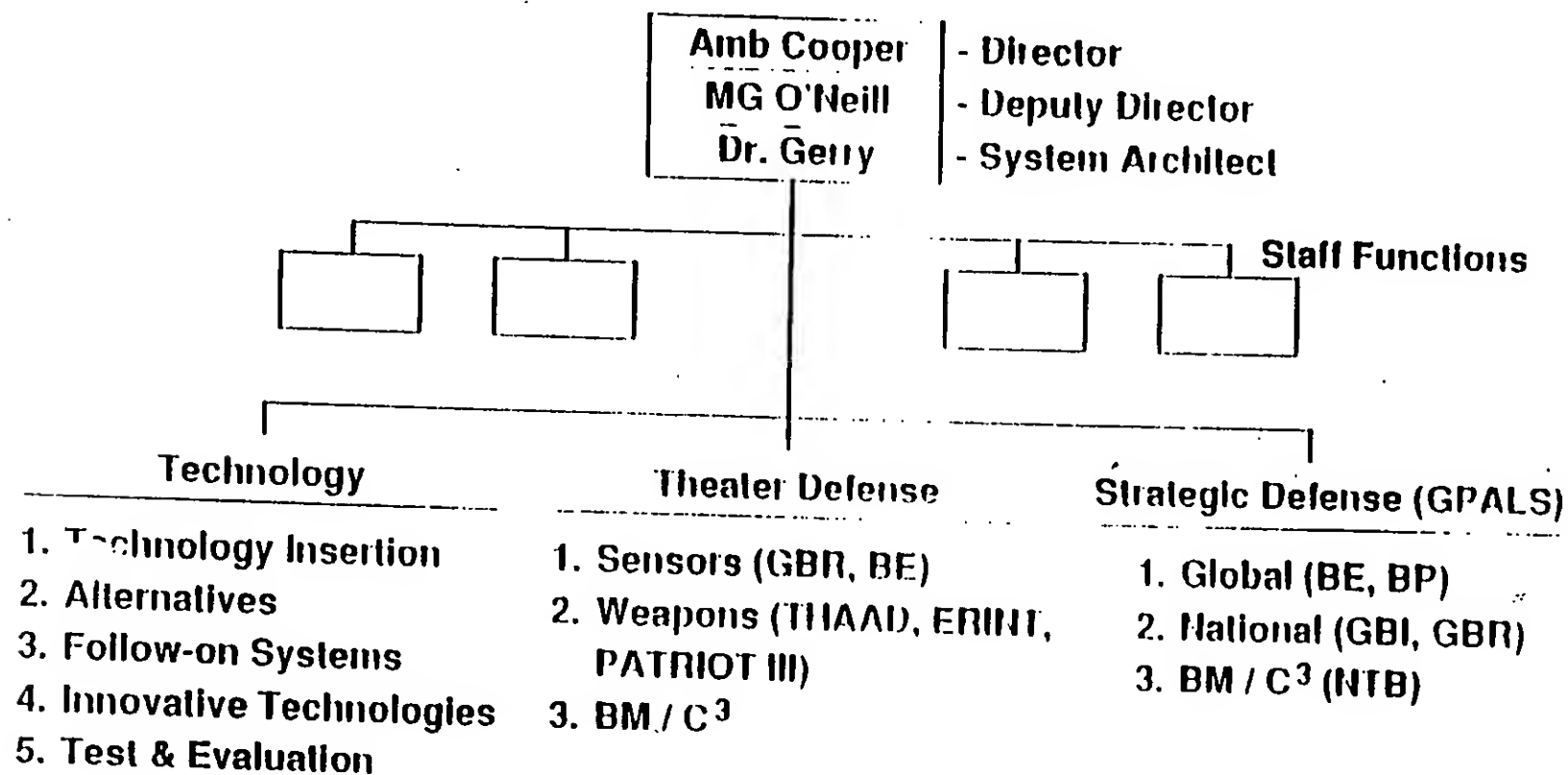


**Col Simon P. (Pete) Worden, USAF  
Deputy For Technology  
Strategic Defense Initiative Organization**



UNCLASSIFIED

# SDIO TODAY



UNCLASSIFIED

**TEST AND EVALUATION**

**INTERCEPTOR  
TECHNOLOGY**

**SENSOR TECHNOLOGY**

# **TECHNOLOGY OVERVIEW**

**KEY TECHNOLOGY**

**DIRECTED ENERGY**

**INNOVATIVE SCIENCE  
& TECHNOLOGY**



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# TECHNOLOGY FASTER, CHEAPER AND BETTER

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PL 27511 / 012192



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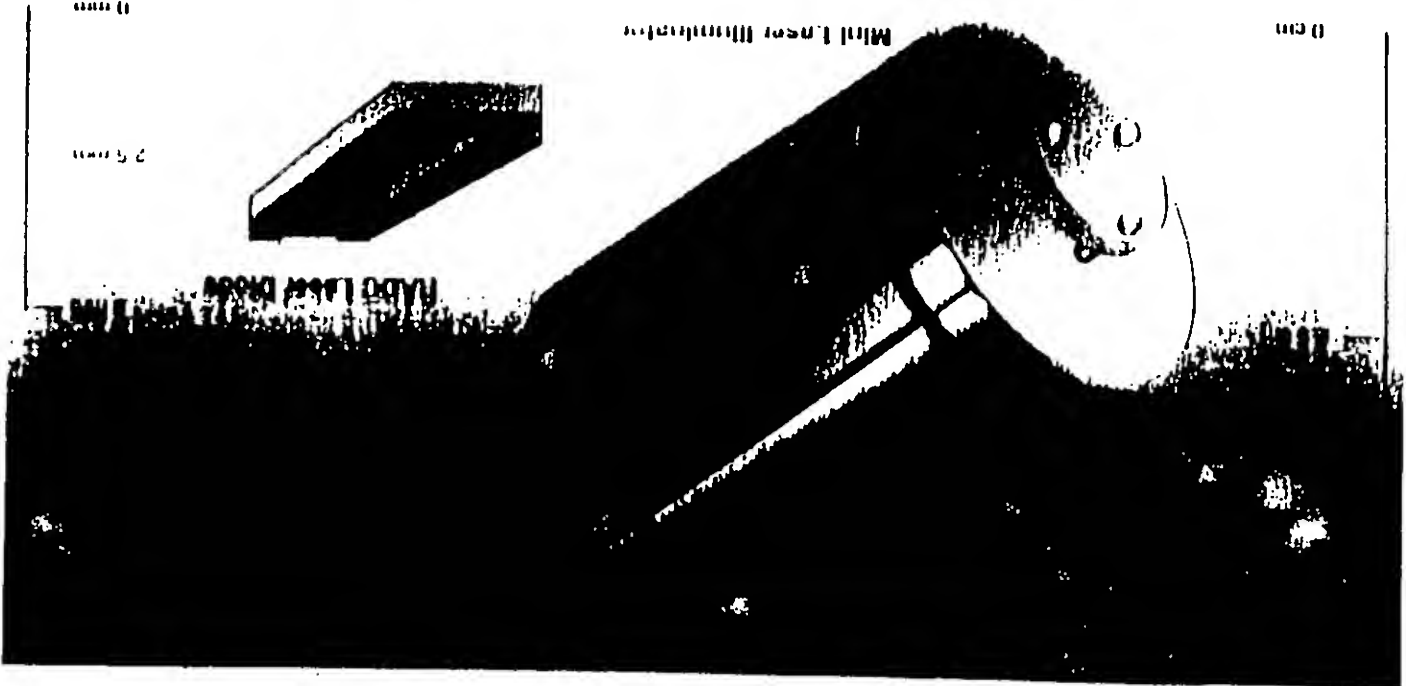
# TECHNOLOGY INSERTION

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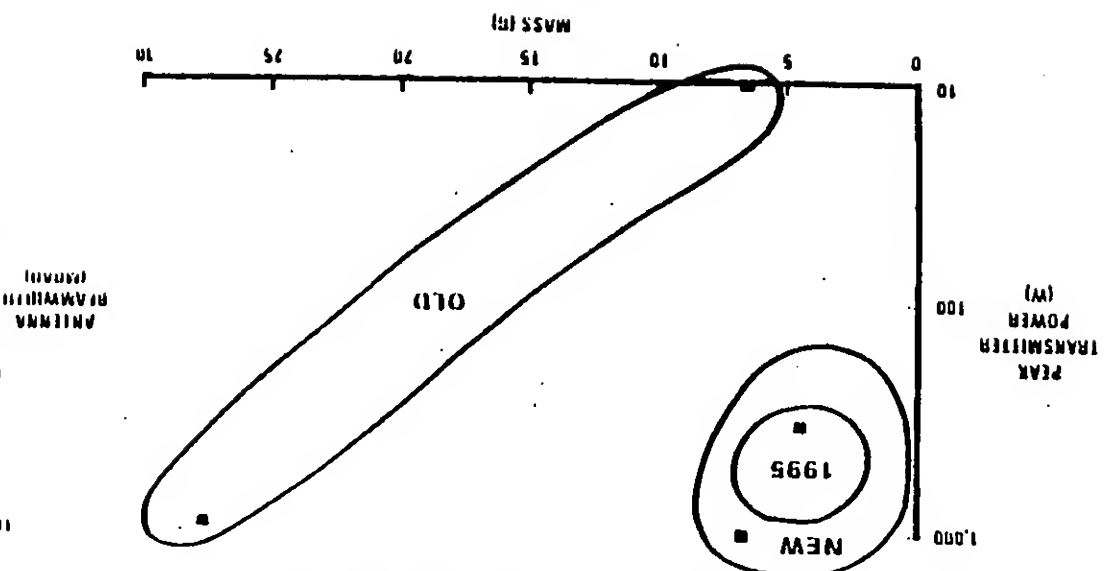
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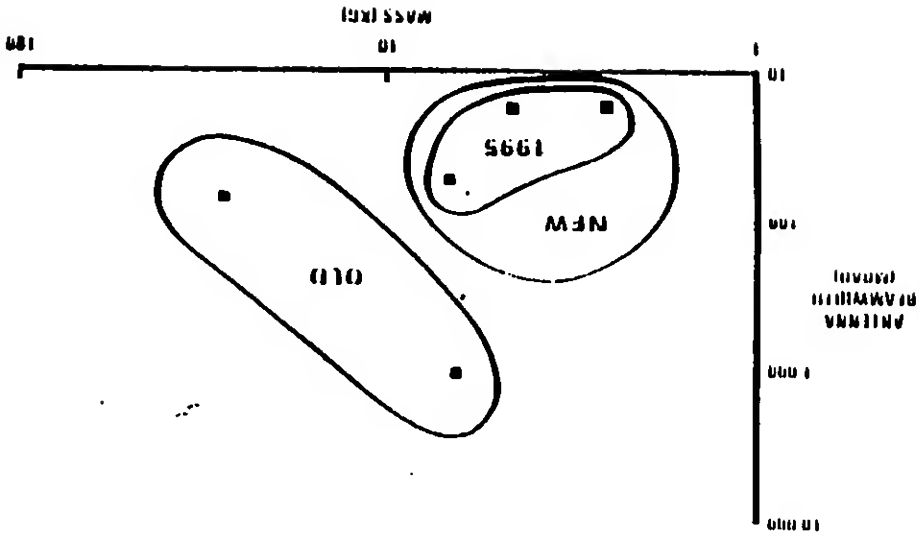
# ACTIVE SEEKERS COMPONENTS



RF TRANSMITTER PEAK POWER VS MASS



RAVAN ANTENNA BEAMWIDTH VS MASS



(UNCLASSIFIED)

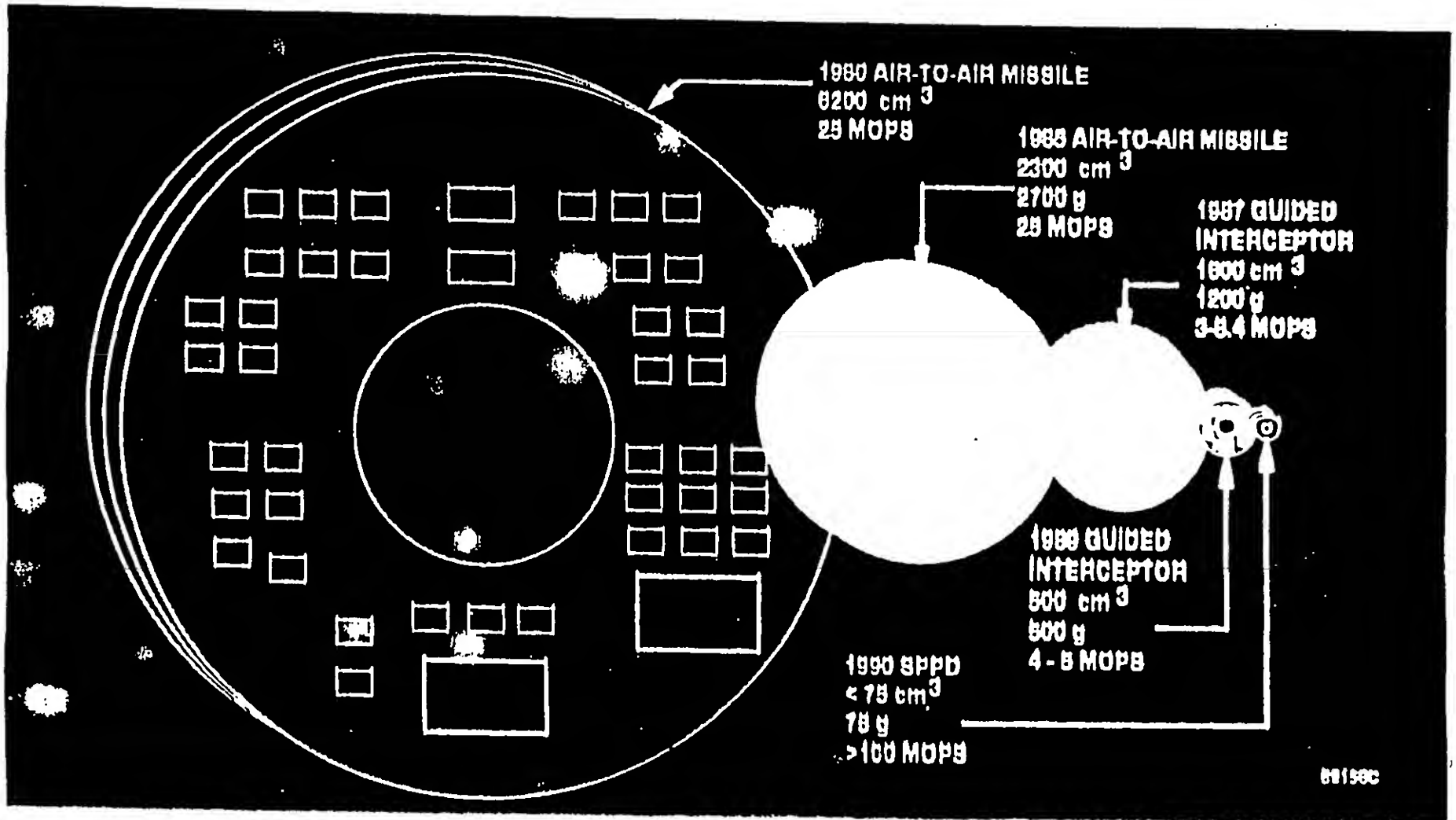
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# SIGNAL PROCESSOR VOLUME IS A KEY DRIVER OF INTERCEPTOR



UNCLASSIFIED

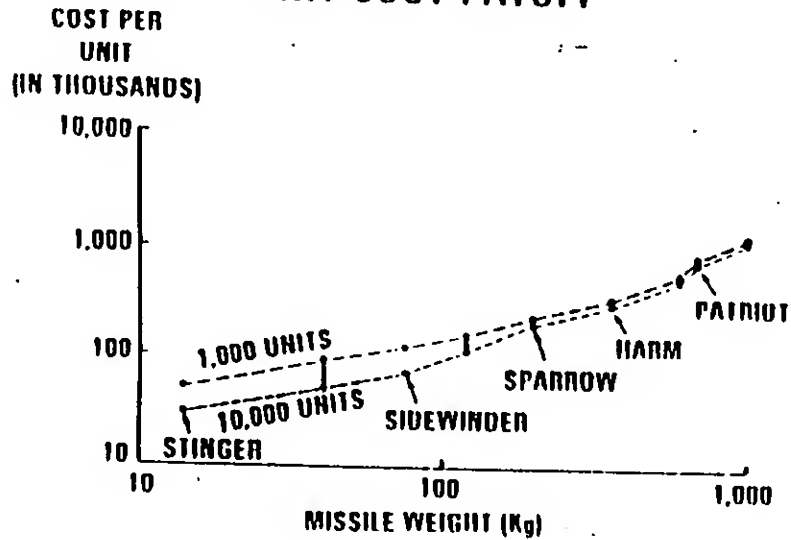
311 2118  
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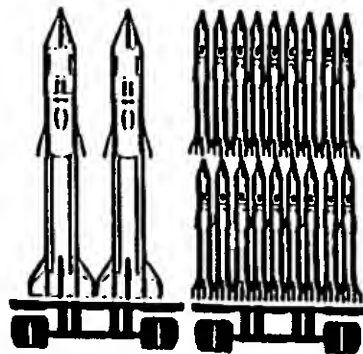
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# BOTTOM LINE ON SIZE AND COST

## UNIT COST PAYOFF



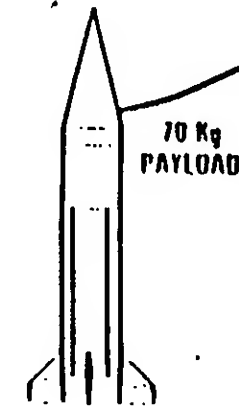
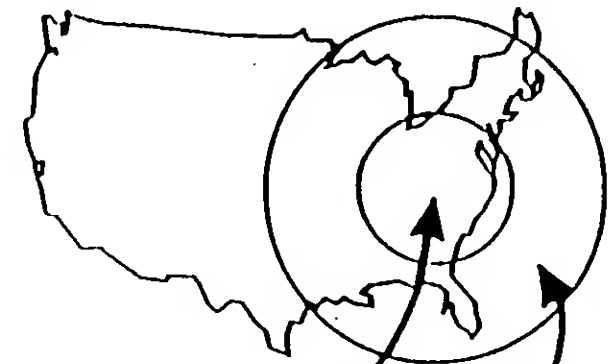
## THAAD MOBILITY LOGISTICS PAYOFF



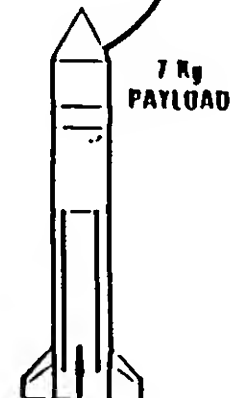
1991                      1996  
**8 TIMES LOADOUT FOR SMALL INTERCEPTORS**

## GBW

### PERFORMANCE LOGISTICS PAYOFF



70 Kg PAYLOAD  
 VELOCITY = 5 Km/sec  
 1991



7 Kg PAYLOAD  
 VELOCITY = 7.2 Km/sec  
 1996

**ONE-TENTH SIZE YIELDS 4 TIMES PROTECTED AREA**

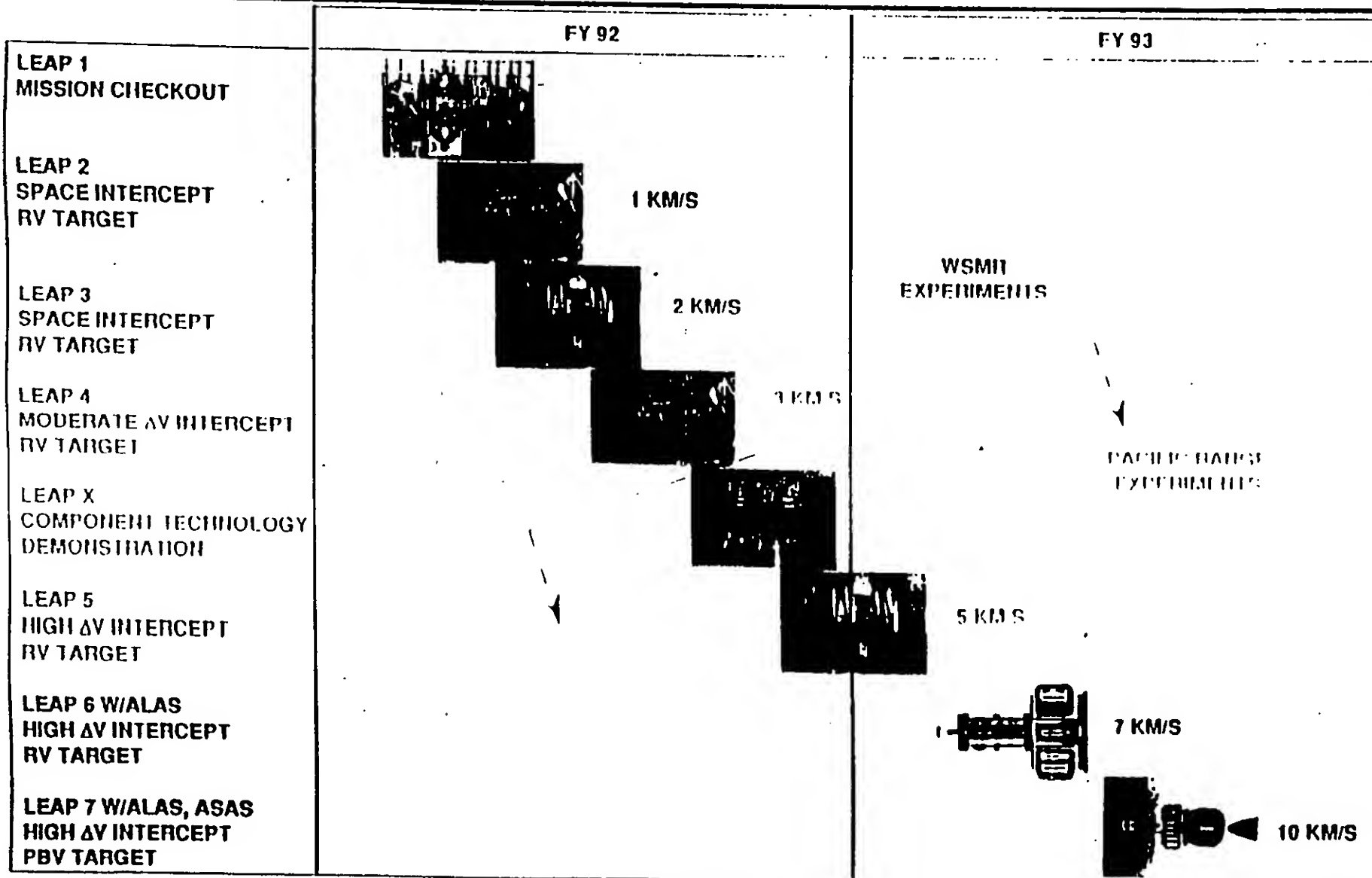
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# LEAP FLIGHT TEST SCHEDULE



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# ALTERNATIVES

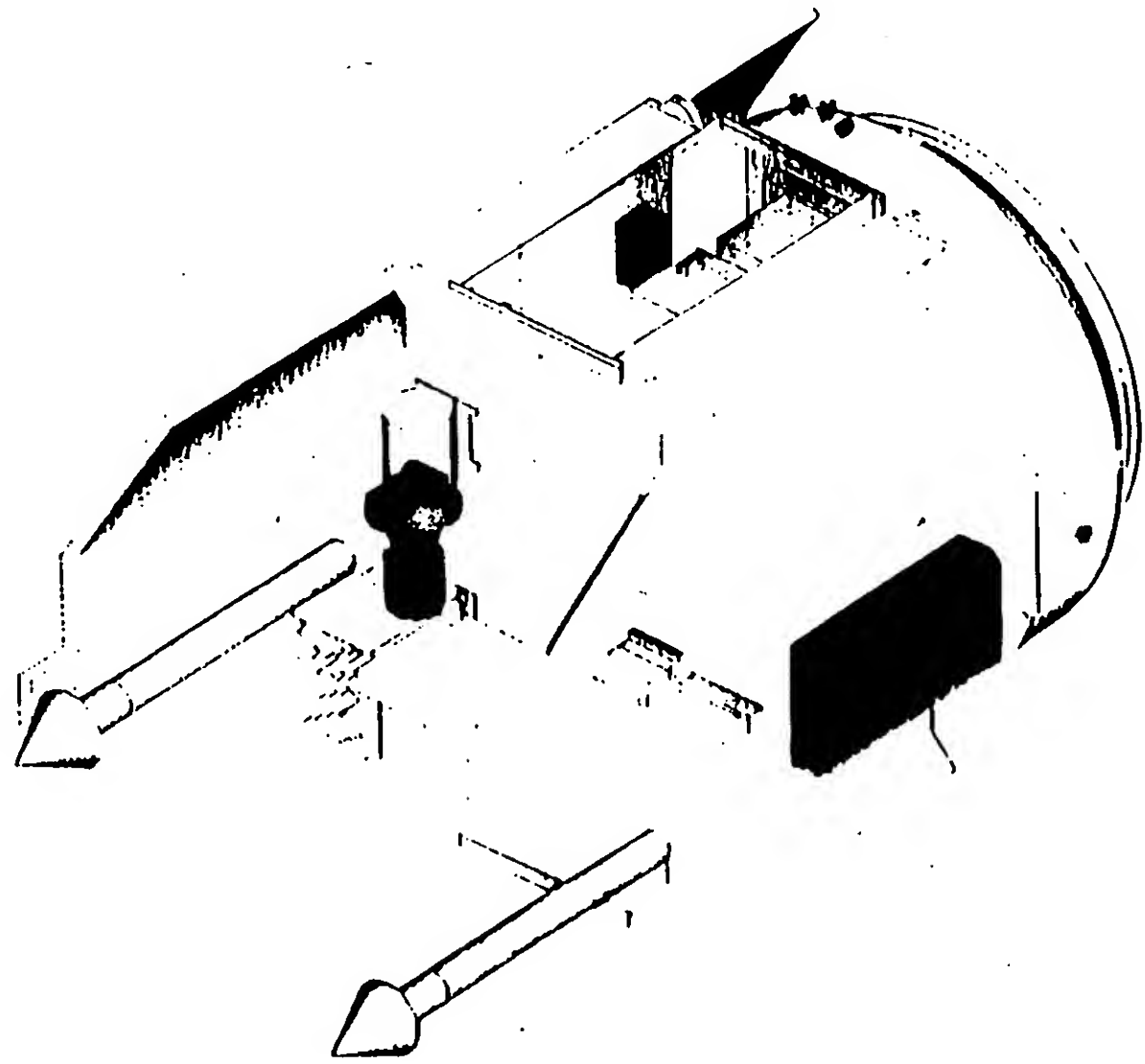
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PN 23516 / 012107



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# MSTI SATELLITE MULTIMISSION BUS CONCEPT



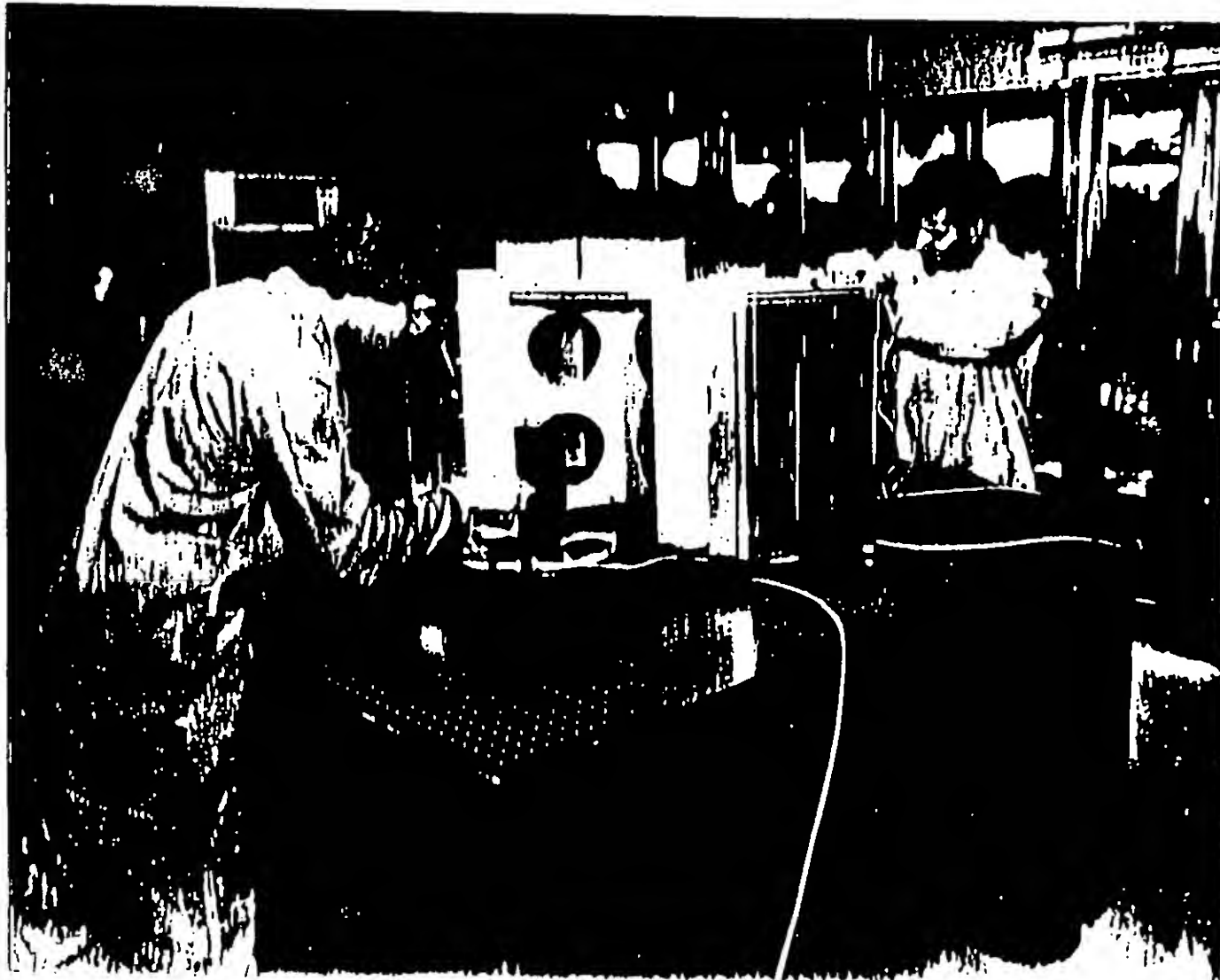
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810 100  
17 Nov 91



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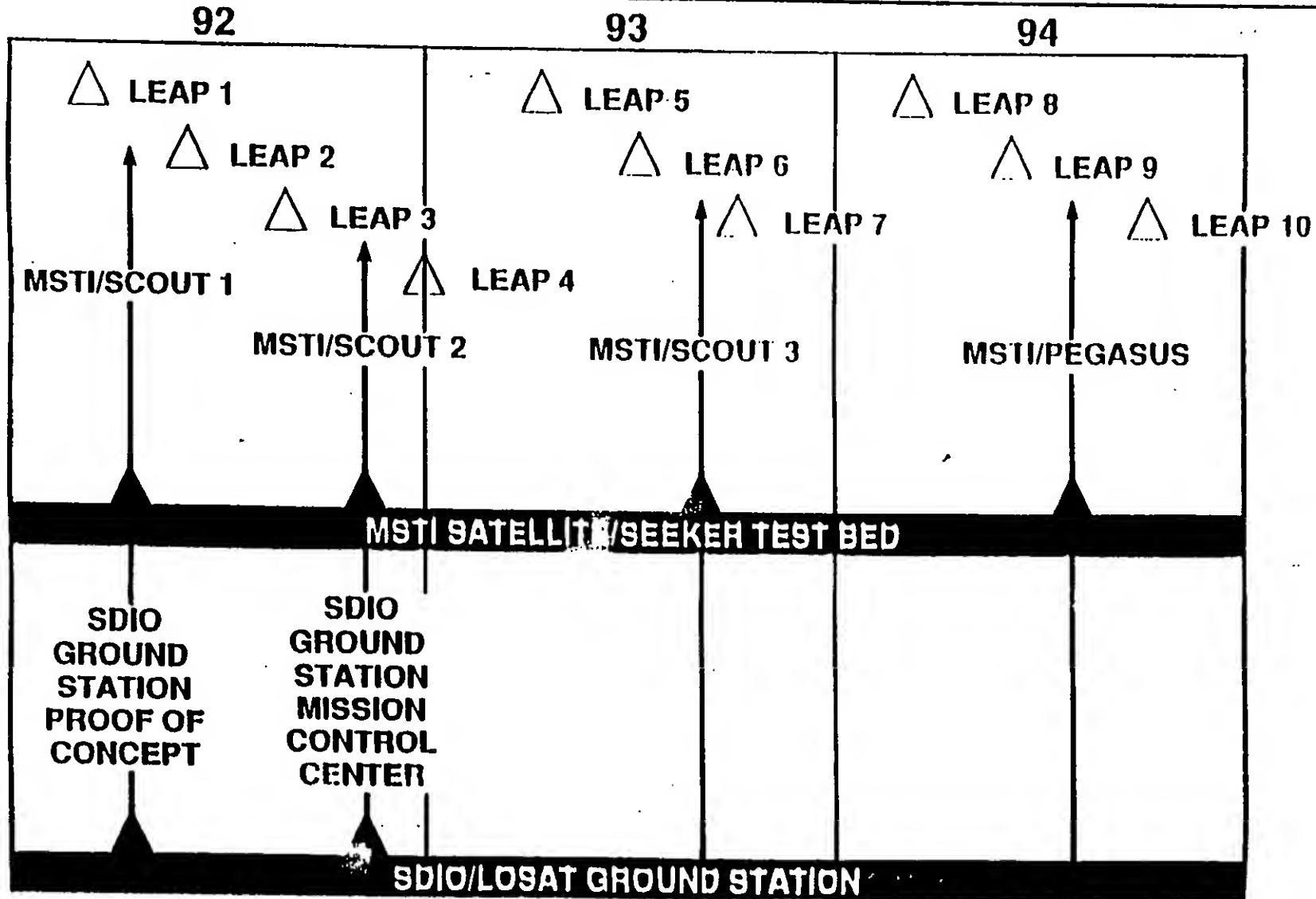
# MSTI SATELLITE INTEGRATION AT PHILLIPS LAB EDWARDS AFB





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# MSTI DEPLOYMENT AND LEAP FLIGHT TESTS



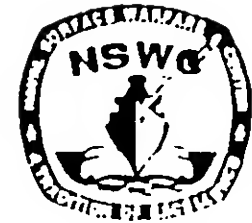
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SDIO FORM 24 10/92

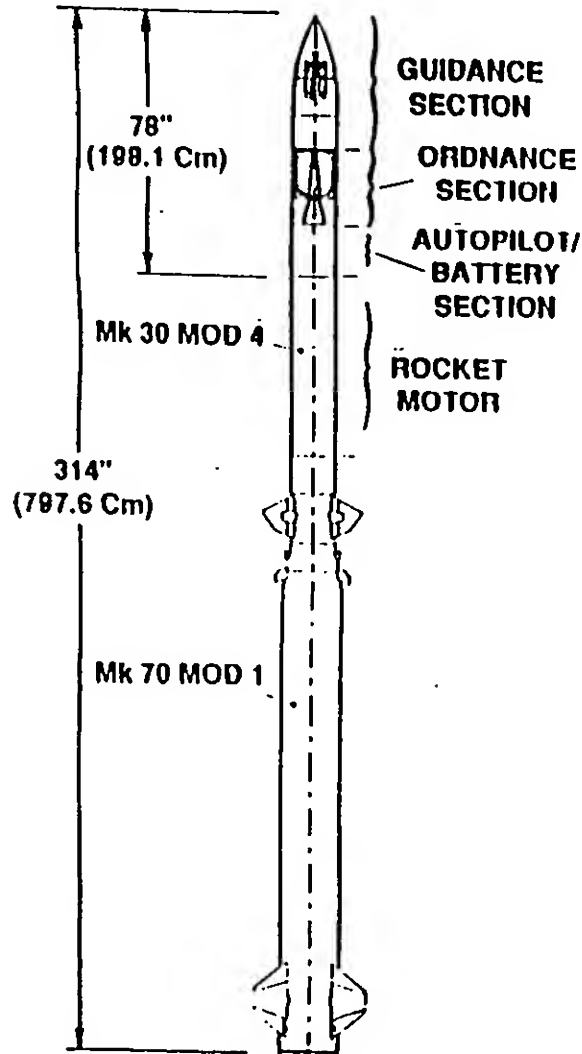


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# LEAP LAUNCH VEHICLE PERFORMANCE USING SM 2 BLOCK II ER (TERRIER) BOOSTER AND SUSTAINER PLUS ASAS



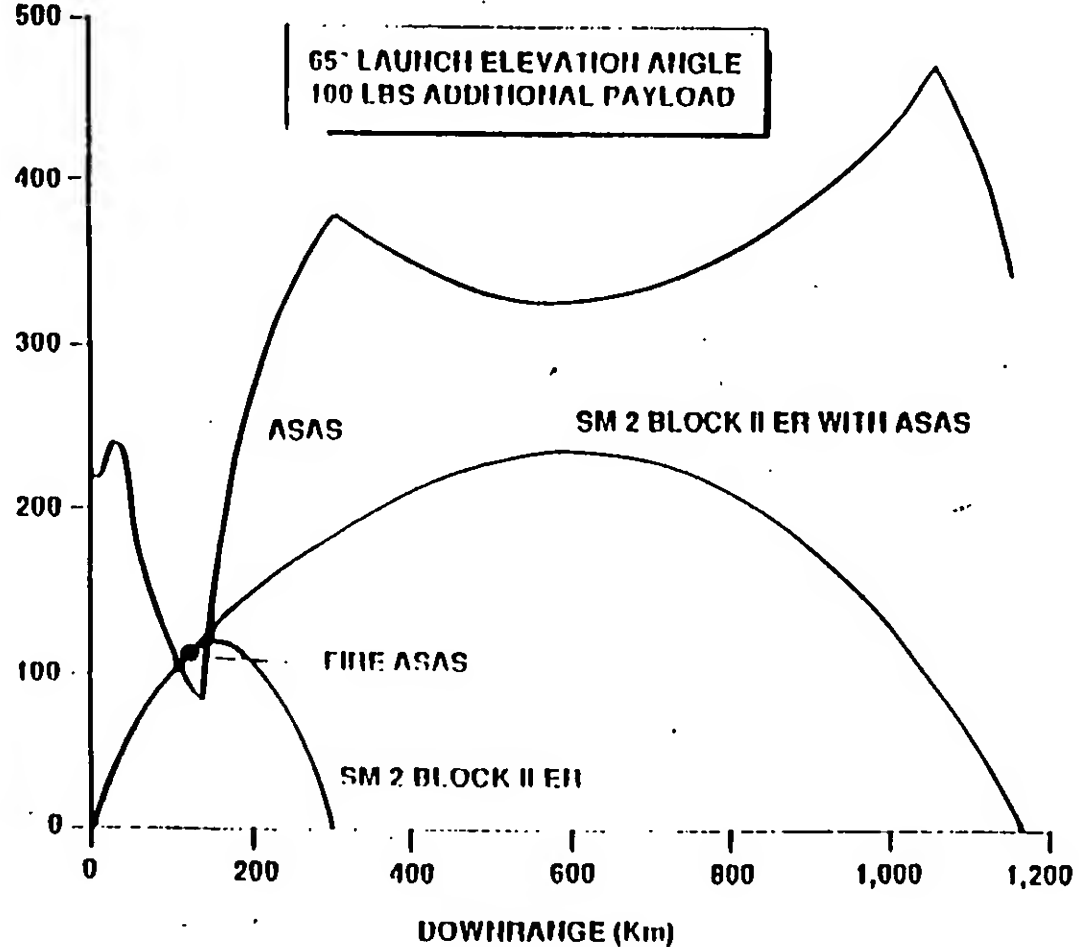
WEIGHT: 3,383 LB (1,522 Kg)  
13.5" (34.3 Cm)



VELOCITY (Kps)

ALTITUDE (Km)

3.5  
3.0  
2.5  
2.0  
1.5  
1.0  
0.5  
0



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91U 101771  
018p 01





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# NAVY LEAP GETS YOU ...



FLIGHT	1	2	3	4	5	6	7	8	9
DATE	FEB 92	MAY 92	SEP 92	DEC 92	FEB 93	MAR 93	JULY 93	SEP 93	DEC 93
RANGE	ATWTF	WSMR			EIR, ATWTF, OR PACIFIC RANGE				
INTERCEPTOR LAUNCH MODE	SHIPBOARD RAIL	DESERT SHIP RAIL			WSMR VLS/RAIL	SHIPBOARD VLS/RAIL	SHIPBOARD VLS/RAIL		
RICH MOTOR	NONE	MASS WAKEUP	ADVANCED SHIELD		BRIEF RANGE TEST				
SUSTAINER		MR 30 MOD 2			MR 30-MR 100				
BOOSTER		SM2 BLOC II			SM2 BLOC II	OR	SM2 BLOC IV		
INTERCEPTOR	MASS WAKEUP	STEP 1 OR		STEP 2 OR	STEP 3				
FIRE CONTROL ELEMENTS	TIMING	TIMING	TIMING	RAOAR TRACK AND ALERT	SHIPBOARD A/CIS (4000) TERRIER				
CLOSING VELOCITY	7.2 KM/S	7.7 KM/S	8.2 KM/S	7 KM/S	2200 KM/S	1.0 KM/S	1.0 KM/S	1.0 KM/S	1.0 KM/S

- 9 FLIGHT TESTS
- 5 AT SEA DEMO
- EARLY SHIPBOARD DEMONSTRATION
- PROVIDES AGGRESSIVE PRE-THAAD TMD ROLE
- MERGES SDIO/NAVY TEST AND TECHNOLOGY INFRASTRUCTURES
- BRINGS NAVY TO TECHNOLOGY READINESS

**NAVY LEAP WILL HAVE DEMONSTRATED EXO-TMD CAPABILITY BY 1993**

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# AIRBORNE LASER

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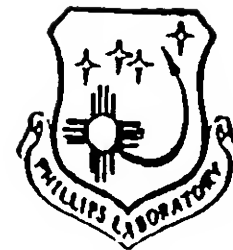
# INITIAL OBSERVATIONS

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- **BOOST PHASE INTERCEPT WOULD BE A COMPELLING ADDITION TO THREATEN MISSILE DEFENSE**
- **AIRCRAFT-BASED LASERS (ABL) OFFER PROMISE IN PROVIDING SUCH A CAPABILITY**
- **ABL IS NOT A NEW CONCEPT; A  $10^{14}$  W/sr CLASS LASER SHOT DOWN AIR-TO-AIR MISSILES IN 1983-84**
- **THE TECHNOLOGY BASE CREATED IN OVER TWO DECADES OF WORK SUPPORTS THE CONCEPT**
- **FOCUSED PROGRAM COULD YIELD OPERATIONAL CAPABILITY EARLY IN THE NEXT DECADE**



# Airborne Laser Laboratory (ALL)



- Demonstrator program: 1970 to 1983
- Laser- High Energy CO<sub>2</sub> GDL (10.6  $\mu$ m)
- 60 cm Pointer telescope
- Demonstrated
  - 6  $\mu$ rad class tracking (1 sigma - 1 axis)
  - Destroyed 5 Air to Air missiles (AIM-9)
  - Destroyed 2 Cruise missiles (BQM-34)



# IRAQ "SCENARIO SUMMARY"

• OPTIMIZED THREAT BASING ASSUMED FOR MAXIMUM OFFENSE CAPABILITY



Threat Class

- I ■ 200 km Range
- II ■ 500 km Range
- III ■ 1000 km Range
- IV ■ 3000 km Range



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# FOLLOW-ON

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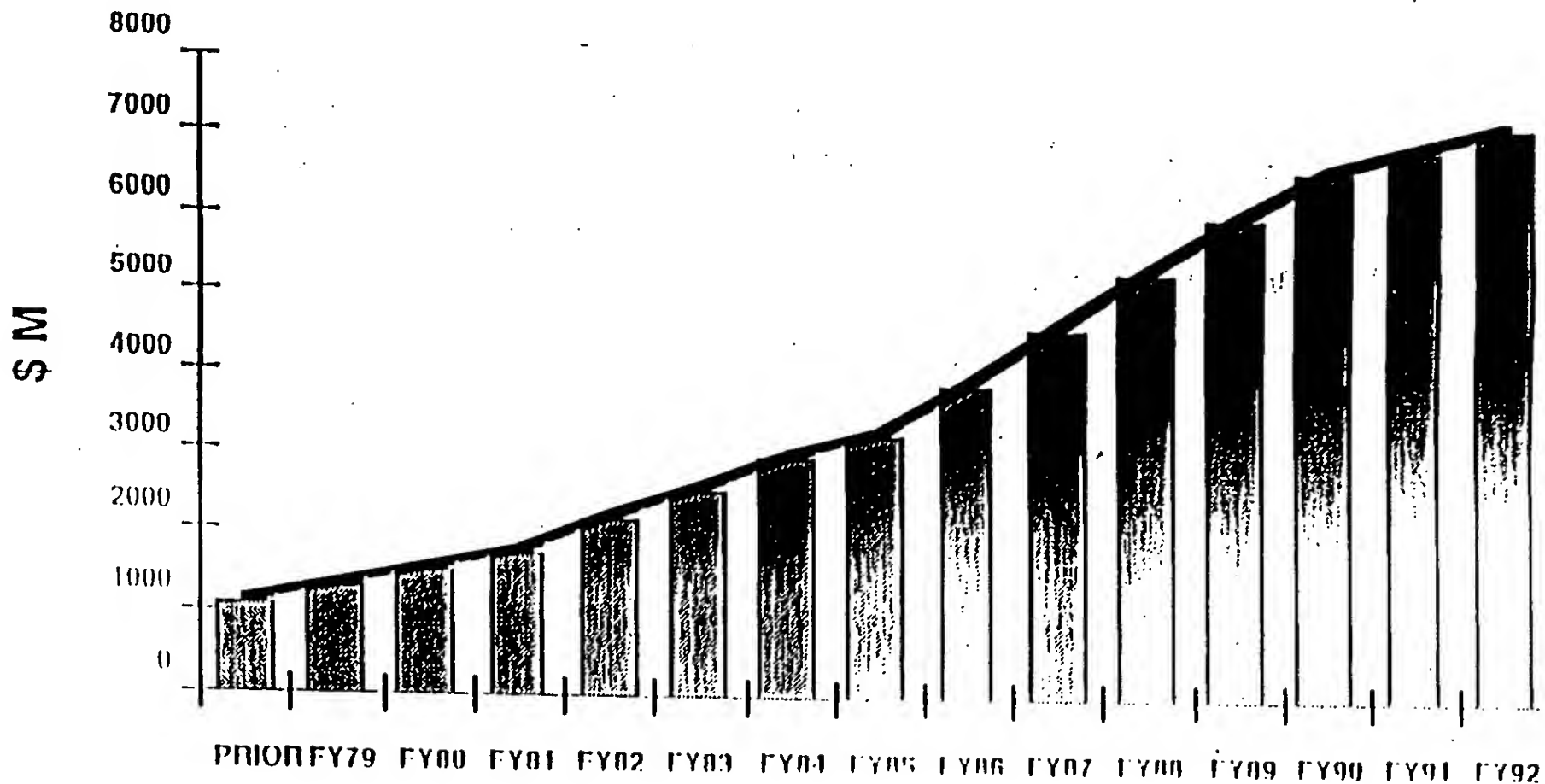
## STARWARS - THE DREAM IS ALIVE AND WELL!

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- DoD Has Made Considerable Investments In Directed Energy (Speed-Of-Light) Weapons Technology For Two Decades
- Pay-Offs Are Emerging Now
  - Near Weapon Level Components Have Been Built And Tested, And Are Now Being Integrated For Mid-90s Tests
- In The Next Decade, This Nation Can Field Truly Unique Weapon Systems For A Broad Variety Of Defense Missions, e.g.
  - Boost-Phase Intercept Of Strategic And Theater Missiles
  - Interactive Discrimination Of Decoys From Warheads
  - Worldwide Full-Time Air Superiority
  - Highly Robust Surveillance



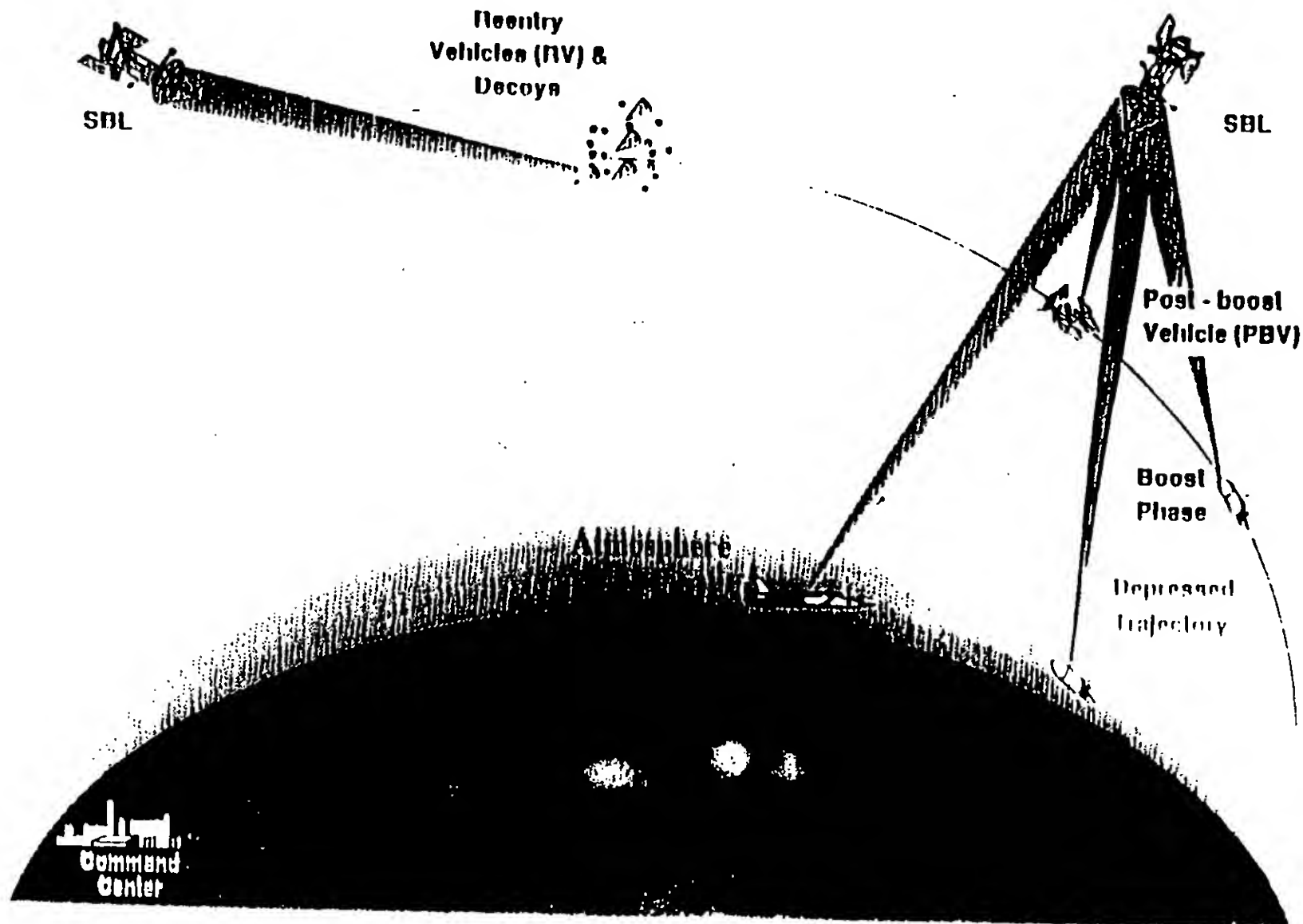
# DIRECTED ENERGY INVESTMENT THEN YEAR DOLLARS





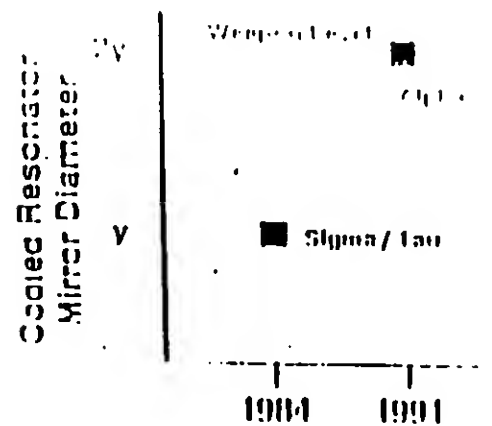
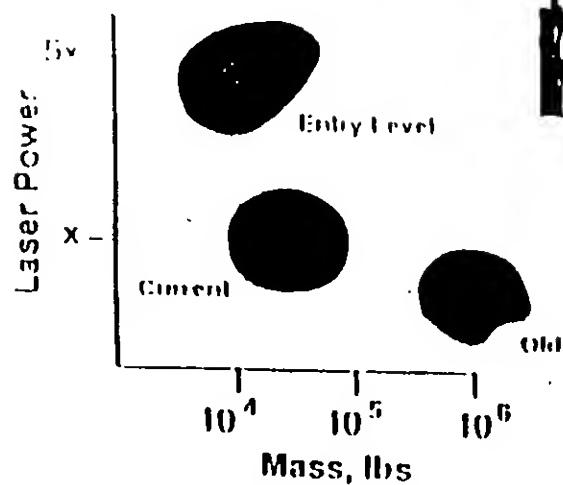
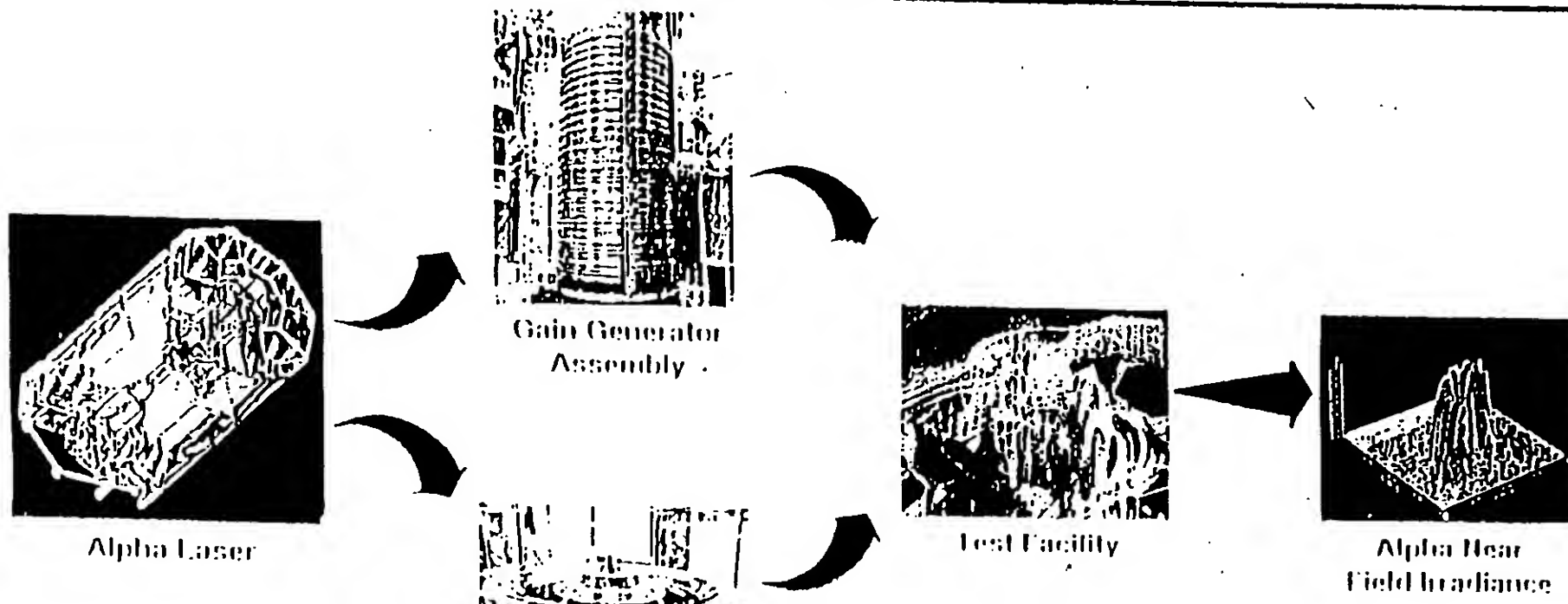


# SPACE BASED CHEMICAL LASER



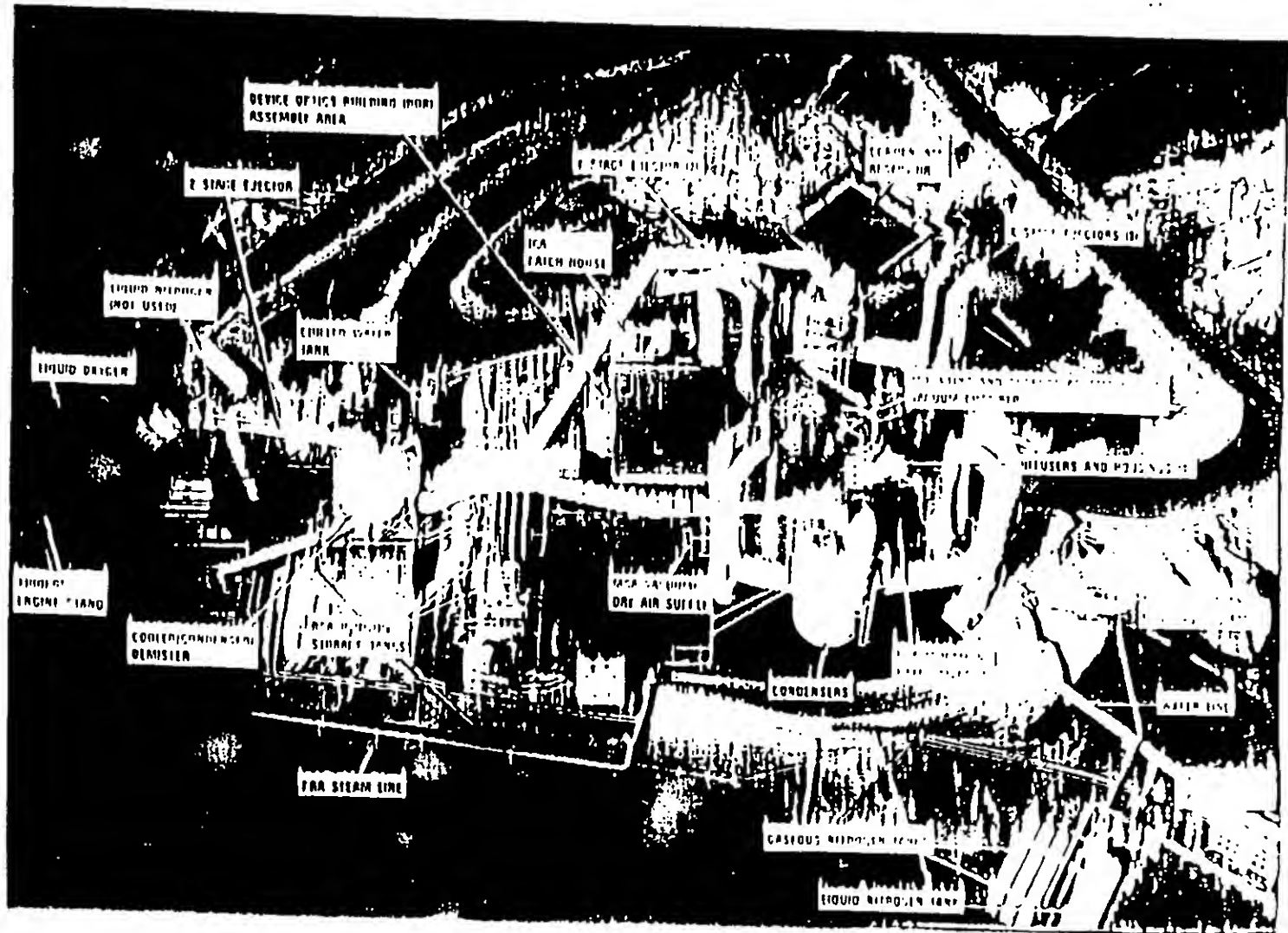


# LASER DEVICE TECHNOLOGY





# ALPHA TEST FACILITY







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# INNOVATIVE TECHNOLOGY

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## MISSION ISSUE

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*Create New Materials To Improve The Performance, Survivability  
And Miniaturization Of SDI Systems*

### *Technical Goal*

- **Thrust The U.S. Into A New "Age" Of Diamond For Windows, Coatings, And Electronics**

### *Payoff*

- **Integrated Circuits With Higher Density, Higher Temperature And Faster Speed**
- **Thin Rocket Windows To Withstand High Speeds**
- **Diamond Hard Protective Coatings For *Everything***

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## DIAMOND PROPERTIES

PROPERTIES	DIAMOND	ALTERNATIVE MATERIAL
HARDNESS (kg/mm <sup>2</sup> )	9000	4500 (Boron Carbide)
THERMAL CONDUCTIVITY (W/m/K)	2000	130 (Silver)
OPTICAL TRANSMISSION (µm)	0.22 to > 100	0.2 to 4 (Silica)
COEFFICIENT OF FRICTION	0.05 - 0.1	0.1 (Teflon)
ELECTRICAL RESISTIVITY (Ωcm)	$1 \times 10^{16}$	$1 \times 10^{15}$ (Alumina)
THERMAL SHOCK (W/m)	10,900,000	10,600 (Zirconia)
TENSILE STRENGTH (kg/mm <sup>2</sup> )	290	35 (Alumina)



**IST**

# DIAMOND

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## DIAMOND PROPERTIES

- HIGH THERMAL CONDUCTIVITY
- HIGH E BREAKDOWN STRENGTH
- RADIATION-HARD
- PHYSICALLY HARD
  
- HIGH-TEMPERATURE (REFRACTORY)
  
- HIGH DIELECTRIC STRENGTH

## APPLICATION

DENSE LOGIC CIRCUITS, HIGH-ENERGY LASER WINDOW COATINGS

U-WAVE & MILLIMETER WAVE POWER

SPACE ELECTRONICS

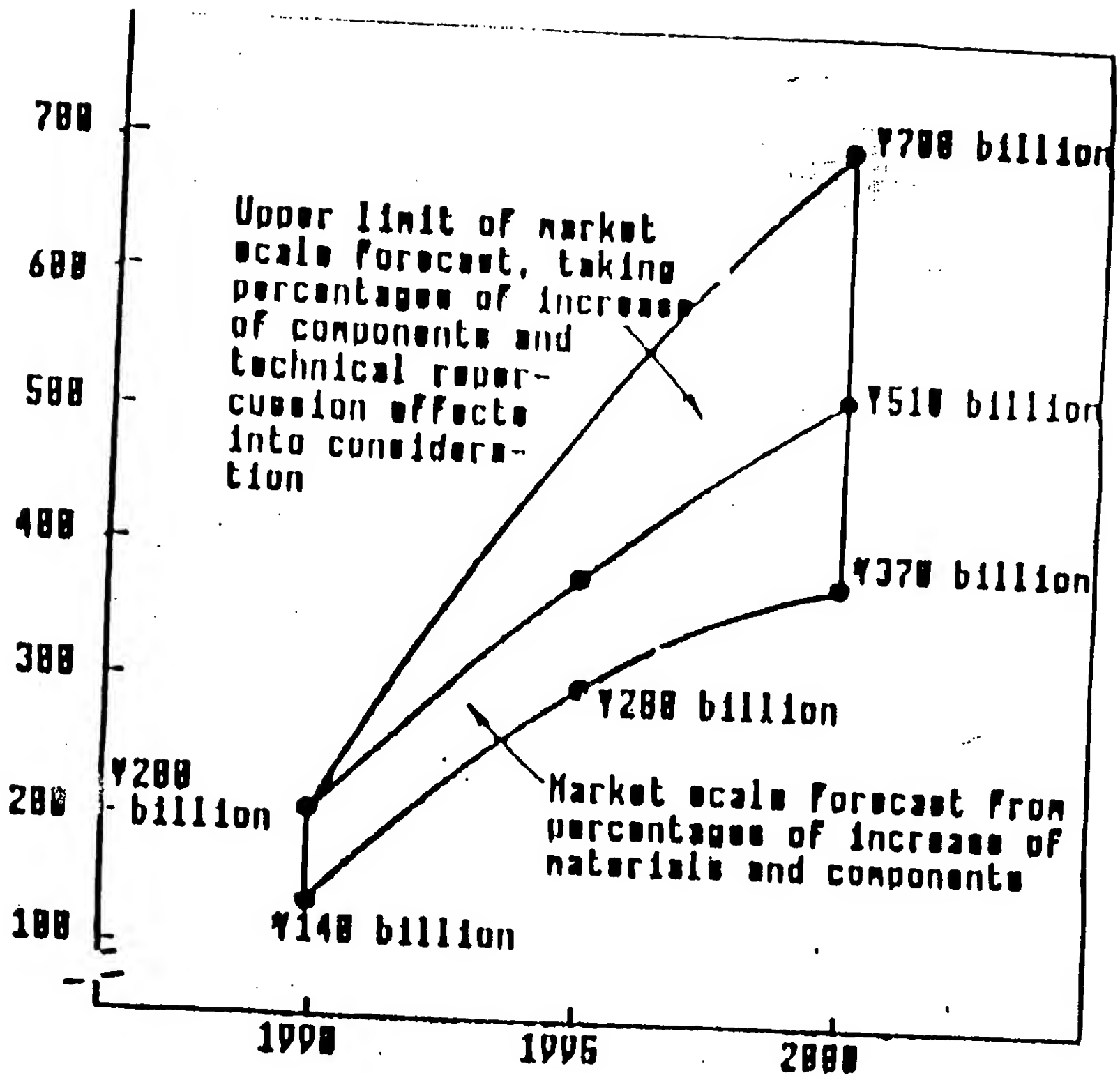
COATINGS: GLASSES, SURGICAL INSTRUMENTS, PROSTHESES, COMPUTER DISCS, AUDIO SPEAKERS

SPACE ELECTRONICS, COMPUTERS, AUTO IGNITIONS & MONITORING

HIGH POWER CAPACITORS, ULTRA-FAST MICROELECTRONICS



Total sales of new diamond materials and components





# LAUNCH SERVICES





## OBJECTIVE

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- CENTRALIZE THE ACQUISITION, MANAGEMENT, AND CONTROL OF LAUNCH REQUIREMENTS AND
  - REDUCE LAUNCH COST (MULTIPLE LAUNCH VS SINGLE LAUNCH PROCUREMENTS).
  - CREATE CENTER OF LAUNCH EXPERTISE
  - MAXIMIZE THE BENEFITS OF LESSONS LEARNED
  - ELIMINATE DUPLICATION OF EFFORT
  - REMOVE LAUNCH VEHICLE / LAUNCH SERVICES RESPONSIBILITY FROM EXPERIMENTER/SCIENTIST



## CURRENT MANIFEST

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### • BASIC CONTRACT FLIGHTS

LEAP 1  
LEAP 2  
LEAP 3  
LEAP 4  
PLACEHOLDER  
SPFE 6 (BP?)

### • SECOND CONTRACT OPTION FLIGHTS

LEAP X  
LEAP 5  
LEAP 6  
LEAP 7

### • FIRST CONTRACT OPTION FLIGHTS

ZEST 1  
ZEST 2  
SPFE DEMO (BP 1M)  
ASTRAL DANCER 1 & 2 (CANCELLED)

### • THIRD CONTRACT OPTION FLIGHTS

ENDO LEAP 1, 2, & 3  
PLACEHOLDER  
PLASMA RADIATION



**PHASE II DC-X  
TECHNOLOGY DEMO**



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## PROGRAM GOALS

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- FLIGHT TEST OF REUSABLE SUBORBITAL ROCKET
- ENABLING TECHNOLOGY DEMONSTRATION
  - APPLICATION OF EXISTING TECHNOLOGY
  - SYSTEMS APPROACH TO LAUNCH
- DEVELOP AND DEMONSTRATE TECHNOLOGY BASE FOR DERIVED VEHICLES COST EFFECTIVE TO SDIO
  - CREATE DATABASE ENABLING A NEW CLASS OF SUBORBITAL TRANSPORTATION
  - ENABLE NATIONAL OPTION TO INVEST IN COST EFFECTIVE SSIO VEHICLE

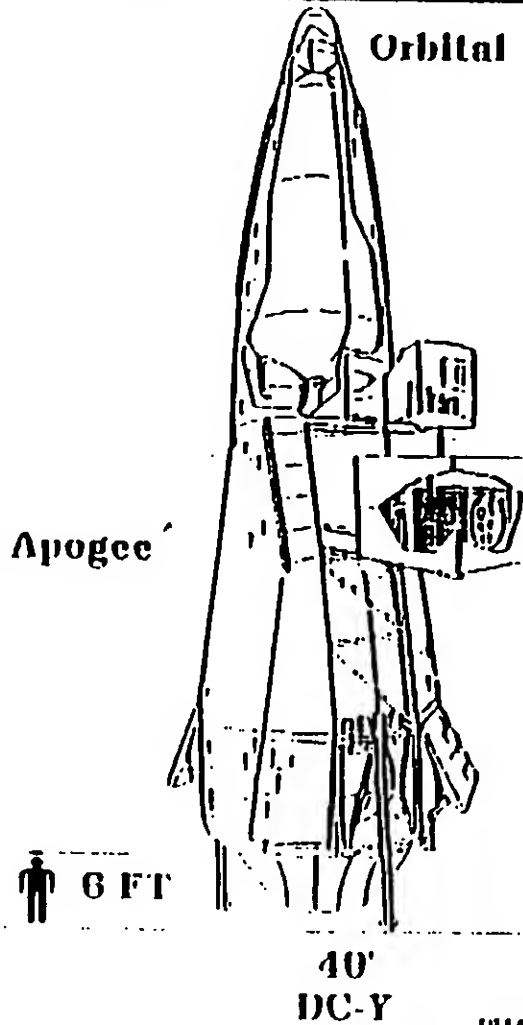
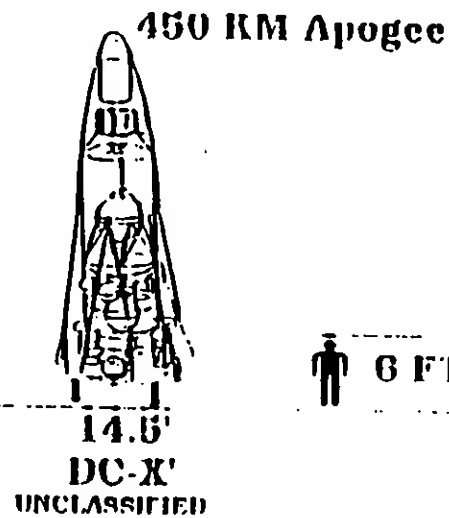
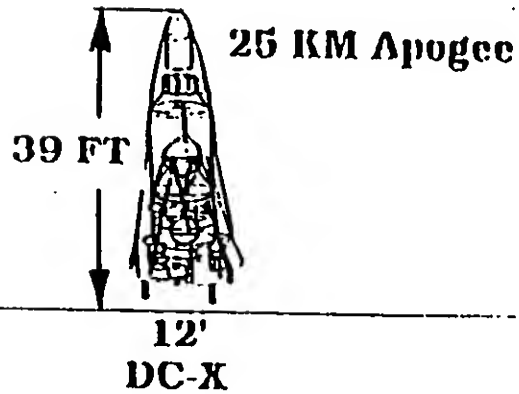
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PHASE II 3



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# POTENTIAL DERIVED VEHICLES



PHASE II 2



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# SCHEDULE

## INCREMENTAL DEVELOPMENT APPROACH

FISCAL YEAR	90	91	92	93	94	95	96	97	98	99	00
Phase I Concept Exploration	Design Selection		Final Reviews		\$15M	4-WAY AIRFRAME COMPETITION					
Phase II Prototype Design & Flight Demonstration		REFA	ADP	IDR	FDR	DC-X Fabrication					
						Flight Test					
						DC-X Prototype Design			\$60M		
						Hardware Demo					
Phase III Experimental Prototype											
									1st Flight	\$510	
Phase IV Operational System	NON SDIO ACTIVITIES										

■ COMPLETED

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## CONCLUSIONS

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- PHASE II IS A TECHNOLOGY DEMONSTRATION PROGRAM TO:
  - DETERMINE IF CURRENT CONCEPTS AND TECHNOLOGIES WILL SUPPORT THE DEVELOPMENT OF A SUBORBITAL RECOVERABLE ROCKET DEVELOPMENT FOR USE IN SDIO SYSTEM TESTING
- SDIO HAS NO PLAN NOR BUDGET FOR FULL SCALE ORBITAL VEHICLE DEVELOPMENT
- PHASE II EFFORTS WILL MAXIMIZE TECHNOLOGY TRANSFER TO A FUTURE ORBITAL VEHICLE

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PHASE II 7